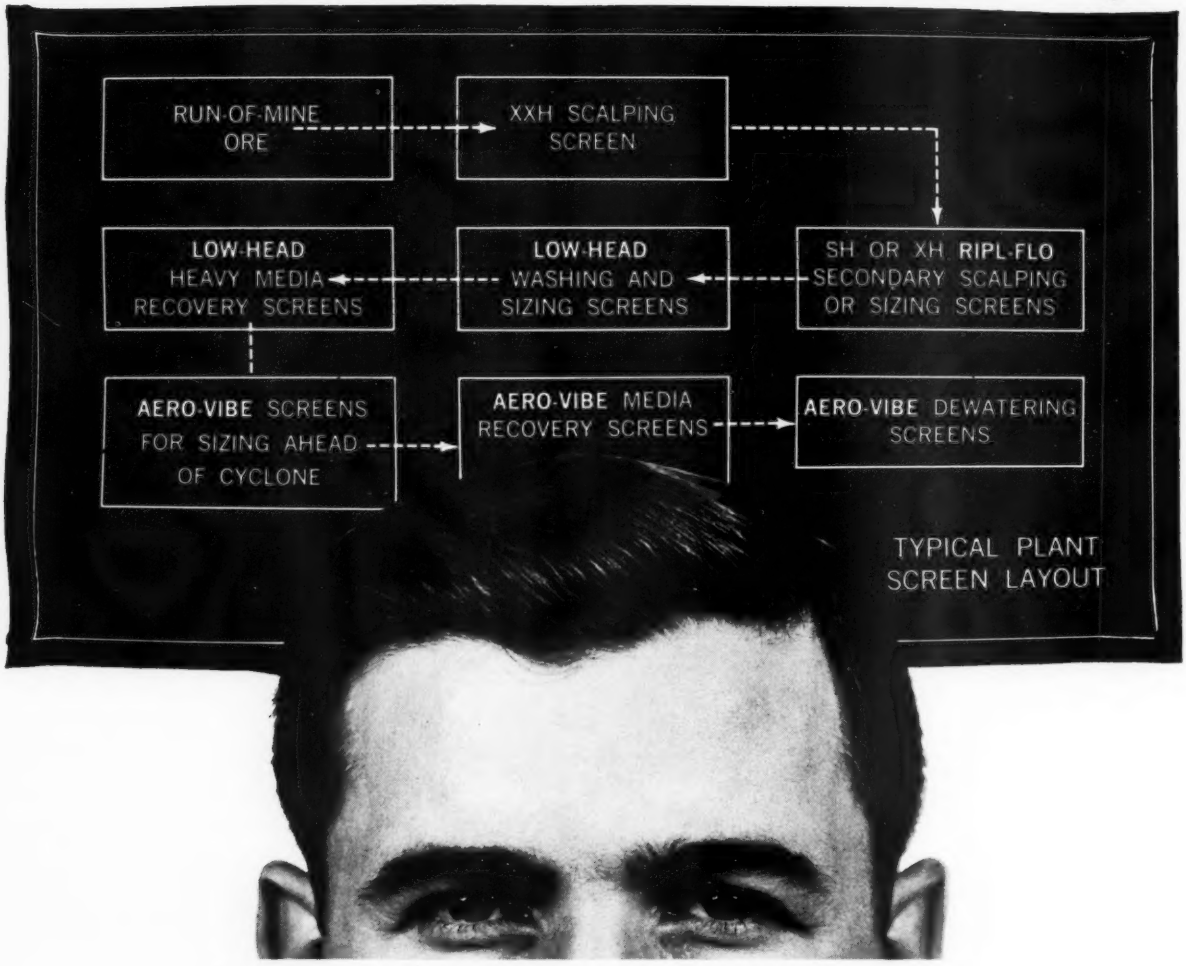
MINING CONGRESS JOURNAL

DECEMBER 1961

Season's Greetings

ALLIS-CHALMERS



Analyze your plant flow, screen by screen:

How much are your screens costing you?

Short cuts in cost can only lead to trouble. There's no "safe" spot where you can economize on equipment. And this certainly applies to screens. They're an important part of the day-in, day-out dependability you have to have throughout your system.

All of your screening operations — scalping, sizing, washing, dewatering, media recovery — carry full responsibility for continuous, uninterrupted flow. To live up to this responsibility, your system needs screens that are engineered to do each specific job. A-C engineering has done just that — with a complete line of screens that assure you top performance under the most rugged conditions.

Ask your A-C representative about the specific features that make A-C screens a dependable part of your system. Or write **Allis-Chalmers,** *Industrial Equipment Division, Milwaukee 1, Wisconsin.* A-1370

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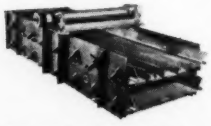
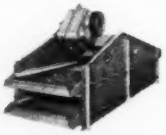
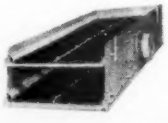


For media drain and dewatering in cyclone plants — AVS **Aero-Vibe** inclined screen.

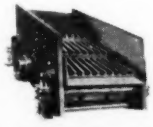


Coarse to fine sizing (wet or dry), rinsing, washing, dewatering and media recovery — **Low-Head** horizontal screen saves headroom too.

For scalping and coarse sizing, wet or dry — XH **Ripl-Flo** rugged cost saving inclined screen.



For light scalping, coarse or fine sizing (wet or dry) rinsing or washing — SH **Ripl-Flo** inclined screen.



For tough primary scalping jobs and high tonnage — XXH **ROM** inclined screen.

MINING CONGRESS JOURNAL

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Opinions expressed by the authors within these pages are their own and do not necessarily represent those of the American Mining Congress.

ARTICLES

SPECIAL SECTIONS

DEPARTMENTS

ON OUR COVER

Concrete headframe at Texas Gulf Sulphur Company's potash project rises above the rugged mesas of southeastern Utah, where the company is investing $30,000,000 for the production of muriate of potash. For details of the project see page 53.

Published Monthly. Yearly subscriptions, United States, Canada, Central and South America, $3.00. Foreign, $10.00. Single copies, $0.75. February Annual Review Issue, $1.25. Second class postage paid at Washington, D. C., and at additional Post Office, Lancaster, Pennsylvania.

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Recent Publications of Interest to Mining Men

USBM RI 5830. "Underground Gasification of Coal: Operation of Multiple-Path System," by John P. Capp, Robert W. Lowe, and Everett F. House.*

USBM RI 5826. "Copper Recovery from Segregation-Flotation Concentrates by Ammoniacal-Ammonium Carbonate Leaching," by M. H. Stanczyk and P. A. Bloom.*

USBM RI 5792. "Analyses of Tipple and Delivered Samples of Coal," (Collected during the Fiscal Year 1960) by S. J. Aresco, C. P. Haller, and R. F. Abernethy.*

USBM IC 8004. "Mining Methods and Techniques Used at the Radon Longwall Operation, Hecla Mining Co., San Juan County, Utah," by W. L. Dare and P. M. Lindstrom.*

USBM IC 8024. "Costs of Mining Under Bolted Roof and Timbered Roof in Bituminous Coal Mines," by M. J. Ackerman and J. J. Wallace.*

USBM IC 8012. "Mining, Milling, and Water-Control Methods, Rosiclare Fluorspar Works, Aluminum Co. of America," by Ronald W. Schaefer, William H. Harrison, and Frank J. Myslinski.*

*** Available from Publications Distribution Section, Bureau of Mines, 4800 Forbes Ave., Pittsburgh 13, Pa.**

USGS Bulletin 1070-C. "Distribution of Uranium in Rocks and Minerals of Mesozoic Batholiths in Western United States," by Esper S. Larsen, Jr., and David Gottfried.**

USGS Bulletin 1136. "Coal Reserves of the United States—A Progress Report January 1, 1960," by Paul Averitt.**

USGS Bulletin 1084-K. "Beryllium Content of American Coals," by Taisia Stadnichenko, Peter Zubovic, and Nola B. Sheffey.** Price 70 cents (paper cover)

**** For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.**

"Can the Research Scientist Acquire a Management Attitude?" by M. R. Nestor. Publications Office, Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio.

"The Flotation Index for the Year 1960,"—a bibliography of 517 articles which have appeared in leading mining publications. Public Relations Department, The Dow Chemical Company, Midland, Michigan.

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THIS MONTH

—MCJ Presents —and the AUTHORS

MINING AT CRAIGMONT

Under development for the past two years, the Craigmont mine at Merritt, B. C., is now producing from an open pit containing over 8,000,000 tons of 1.8 percent copper ore. Underground mining will begin in about one year and eventually all production will come from underground. See page 26.

Robert Hallbauer was employed by Canadian Exploration Ltd. from 1954 to 1960, serving consecutively as surveyor, shift boss, mine engineer and chief engineer at Salmo, B. C. In 1960, he was transferred to Craigmont Mines Limited as mine superintendent at Merritt, B. C.

SHOOTING WITH AIR IN LOW COAL

A new drilling and air shooting machine for low coal has made it possible for this operation to keep ahead of the loading machine at the Tioga mine of Maust Coal & Coke Corp. Air shooting has increased the amount of coarse sizes, decreased the amount of fines and reduced preparation plant costs. See page 31.

Joe L. McQuade is senior executive vice president of the Maust Coal & Coke Corp., Richwood, W. Va.

PLANT SERVICES PROGRAM AT BUNKER HILL

The various plants at the Bunker Hill Company's Kellogg, Idaho, operation existed almost as separate companies before a major reorganization that created the Plant Services Division with company-wide responsibilities. How the division operates is discussed as well as problems encountered since reorganization. See page 36.

LeVern M. Griffith has been manager of plant services at The Bunker Hill Co. for six years. He came to Bunker Hill in 1941 as an electrical engineer and subsequently became electrical superintendent, mechanical and electrical superintendent, and plant engineer. He was with the U. S. Forest Service before joining Bunker Hill.

FINE COAL CLEANING WITH HEAVY MEDIUM CYCLONES

Bethlehem Mines Corp. chose heavy medium cyclones for its new 150-tph Century coal preparation plant at Buchannon, W. Va. The cyclones, cleaning Redstone seam coal, have made separations at specific gravities as low as 1.31. The article begins on page 42.

(Continued on page 5)

William Benzon has been with Bethlehem Steel for 26 years. Two years were spent in coke plant operations, 10 years in research for coal and coke, and 14 years in coal preparation. He is now superintendent of preparation for Bethlehem Mines Corp., a subsidiary of Bethlehem Steel.

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This Month (continued) —and the AUTHORS

TEXAS GULF SULPHUR COMPANY'S NEW POTASH PROJECT

Construction is well under way on a $30,000,000 project which will tap one of the richest potash deposits in the United States located in southeastern Utah. A 2800-ft shaft, that will be capable of handling 12,000 tpd, is being sunk and a mill, designed in 4000 tpd units, is being erected and will be producing muriate of potash late next year. Progress to date is covered in the article starting on page 53.

Charles F. Fogarty and Frank E. Tippie have both been with Texas Gulf Sulphur Co. since 1952. Fogarty is presently senior vice president, having joined the company as assistant manager of exploration. Tippie became project manager at the company's potash operations in 1960.

GERMAN IMPORTS OF U. S. COAL

The European Coal and Steel Community is making some basic adjustments in the European coal industry. Uneconomic mines are being closed and the eventual dropping of import quotas and discriminatory duties will win a permanent European market for American coal. See page 56.

Omer Anderson has been a correspondent since 1947 in Germany. He has reported for INS, Stars and Stripes, Reuters and the North American Newspaper Alliance. He has reported on German mining conditions on several occasions in recent years to readers of Mining Congress Journal

GRATE-KILN PELLETIZING AT HUMBOLDT

Production of 2000 long tpd of high-quality iron ore pellets from low-grade crude ores began at Humboldt Mining Company's fully integrated plant on the Marquette Range in 1960. The entire operation is described, with emphasis on the pelletizing process, in the article beginning on page 61.

Robert W. Berkhahn and Daniel M. Urich are, respectively, operating metallurgist and metallurgist, The Cleveland-Cliffs Iron Co. Berkhahn's metallurgical experience covers the past 12 years; since 1955 he has been in charge of plant operations at the Humboldt mine. Urich has served Cleveland-Cliffs in both research and plant operations since 1957.

INCREASING EQUIPMENT AVAILABILITY THROUGH MAINTENANCE

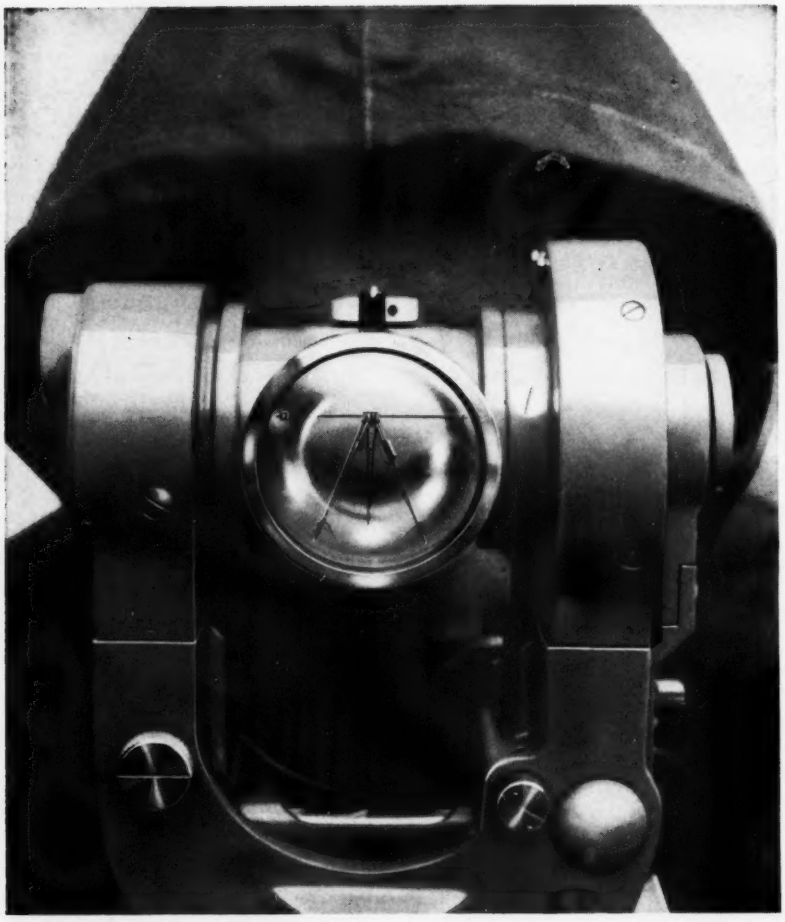
Discussing the philosophy of maintenance, the author stresses the need for more cooperation between the manufacturers and equipment users. More service engineering by manufacturers and less abuse of equipment by machine operators would improve equipment performance and reduce down-time. See page 65.

Thomas P. Bradford has served as safety engineer, foreman and production engineer and was recently resident engineer and project engineer for a coal preparation plant. He is maintenance and lubrication engineer for the Hanna Coal Co. at Cadiz, Ohio.

ROLE OF THE PSYCHOLOGIST IN MANAGEMENT

Just as legal counsel, auditors and mining consultants are used by the manager to enrich his own judgment, so can the services of a psychological consultant be used. He can assist management in selecting key men, stimulating creativity, organization planning, and decision making, and can also help the executive to better understand himself and his attitudes. Page 73.

Robert O. Shaffer is a partner in Rohrer, Hibler & Replogle, psychological consultants of management. Shaffer earned a doctorate degree at Cornell University, where he served in various posts including assistant to the president. Following that he was dean of students at State University of New York Teachers College.



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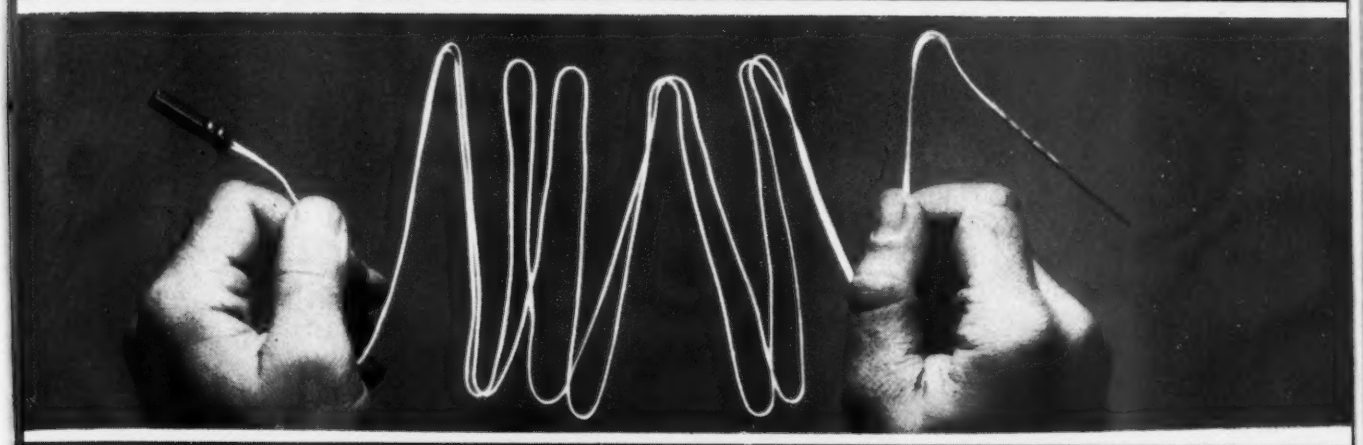

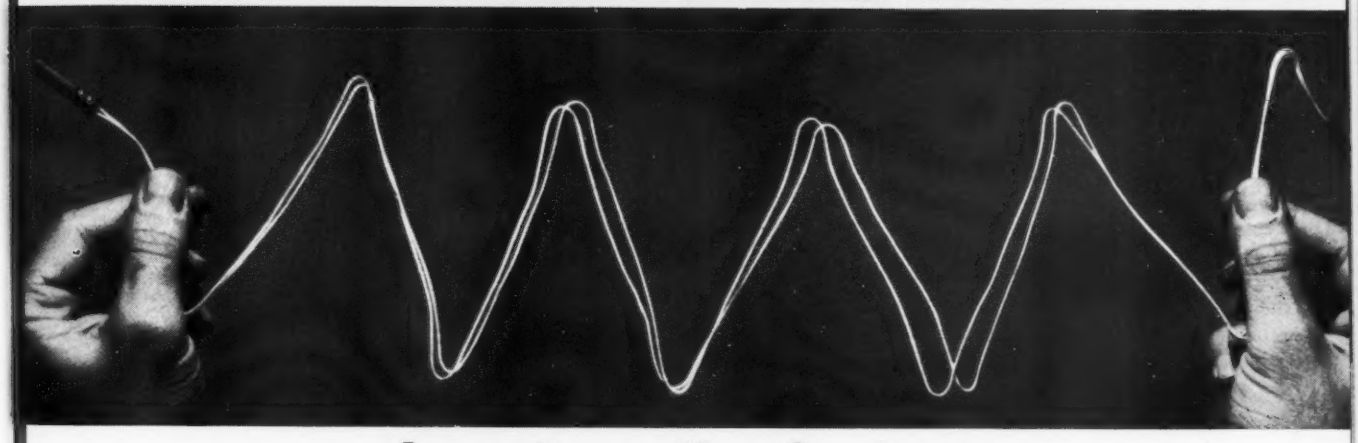

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(and save 30 seconds on each blasting cap connection)

Hold the cap in your left hand and the shunted wire-ends in your right.

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Spread your hands as if you were telling a fish story.

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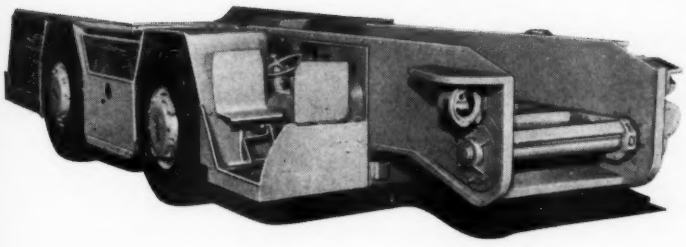

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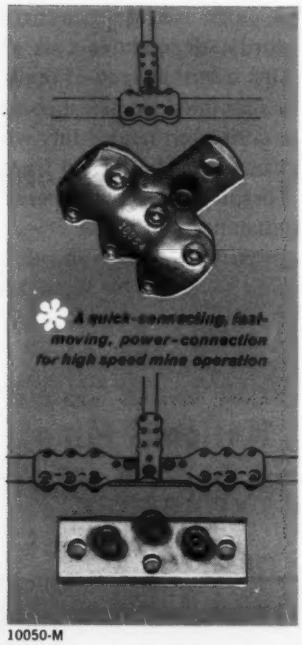

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FAST . . . The new O-B Cable Connector makes or breaks a cable connection simply with the turning of two cap screws. These sturdy fittings are especially designed for sections that are picked up and moved frequently.

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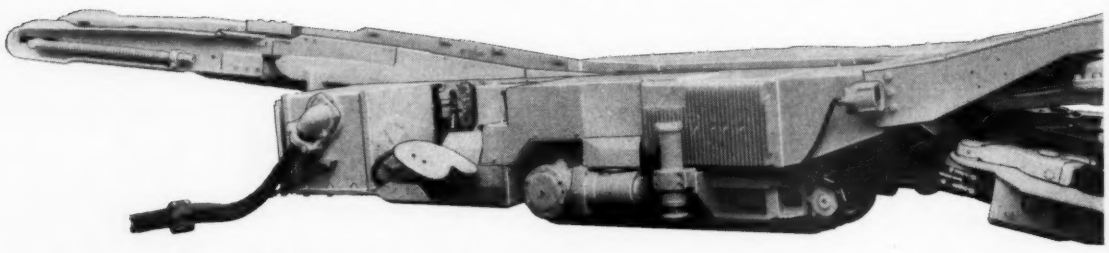
Low tramming and high cutting features increase coal production at extremely low operating costs.

Free-cutting action in a diamond pattern continuously gives uniformly coarser raw coal. The percentage of ¼ x 0 equals that for conventional mining, while per-

The CM32 is 32" high, cuts coal from 36" to 68".



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The business end of the CM32 shows placement of cutters to provide a diamond pattern. Note dual gathering arms of gathering head, and large throat opening of conveyor.

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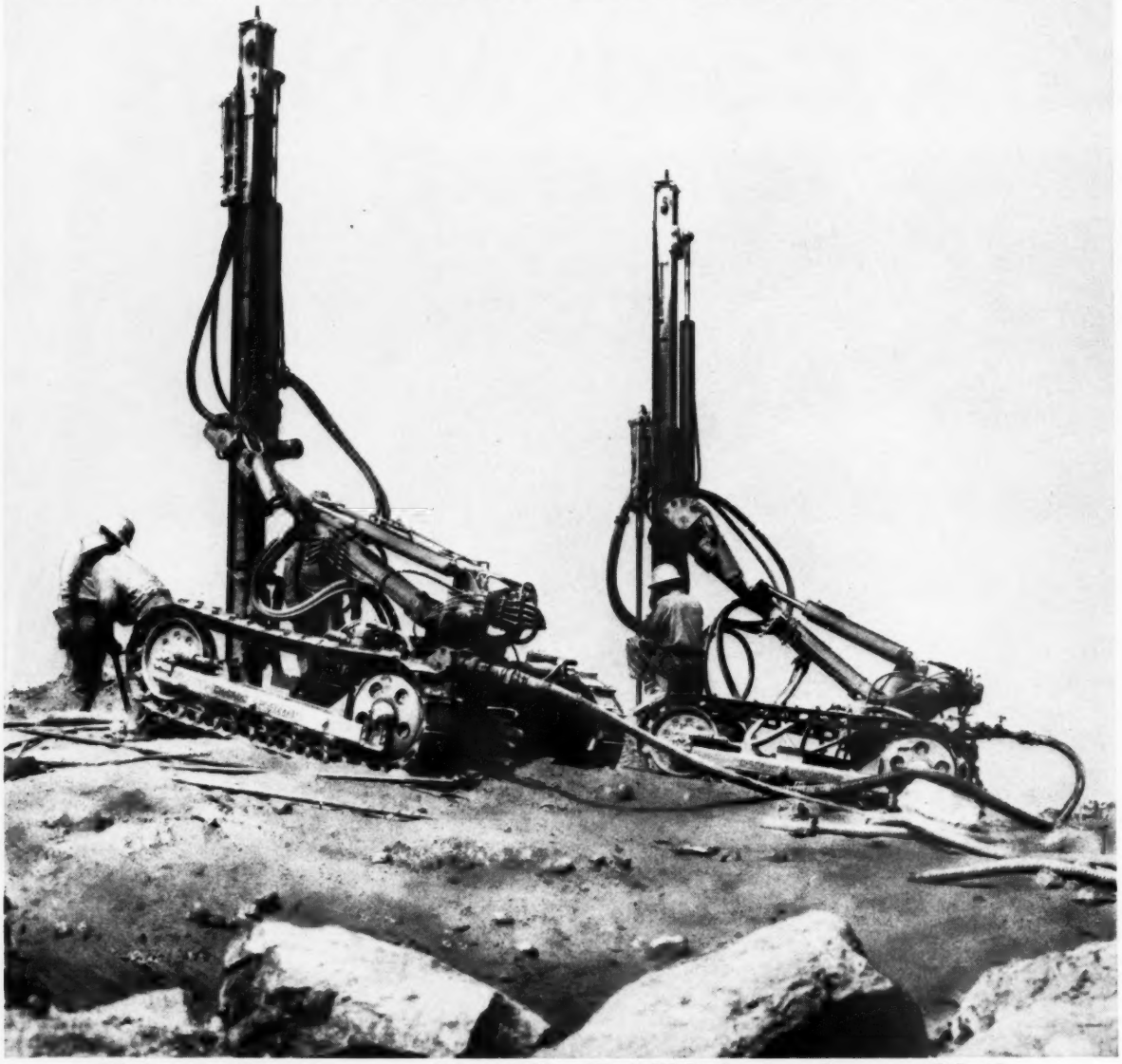

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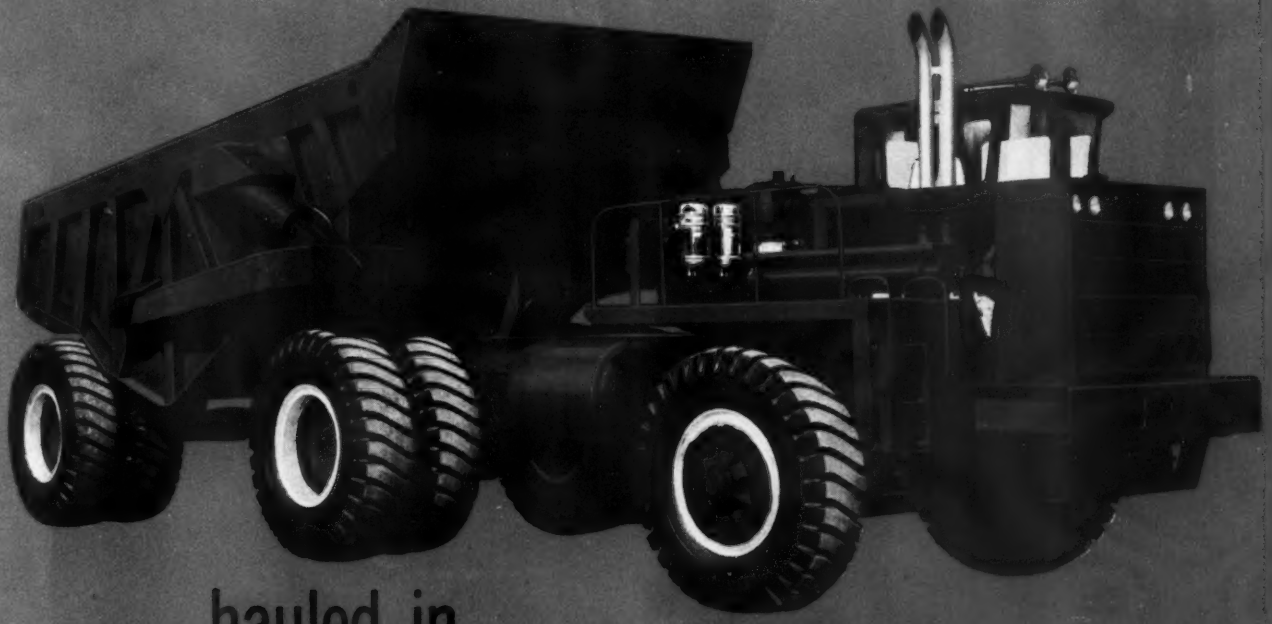

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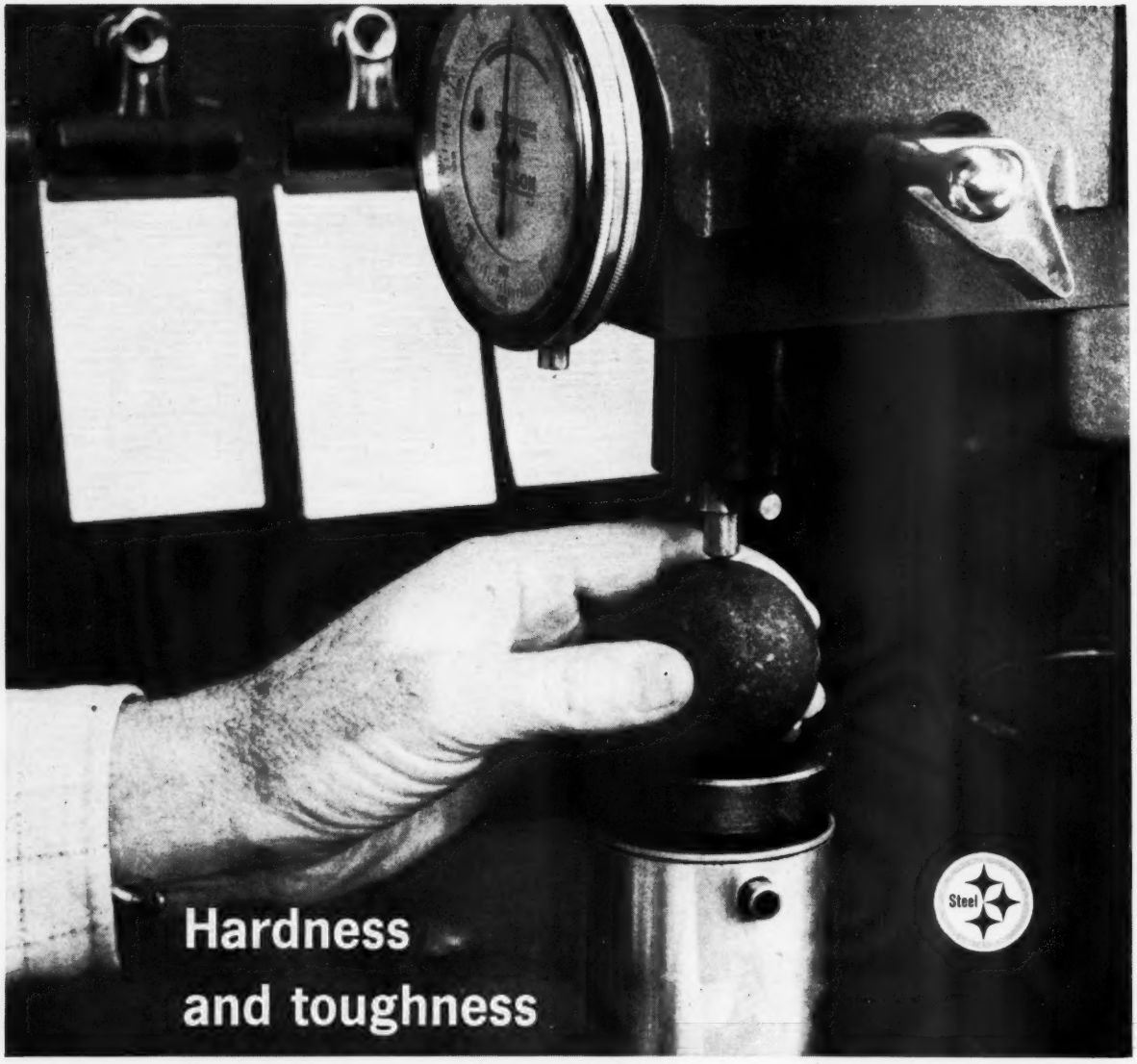

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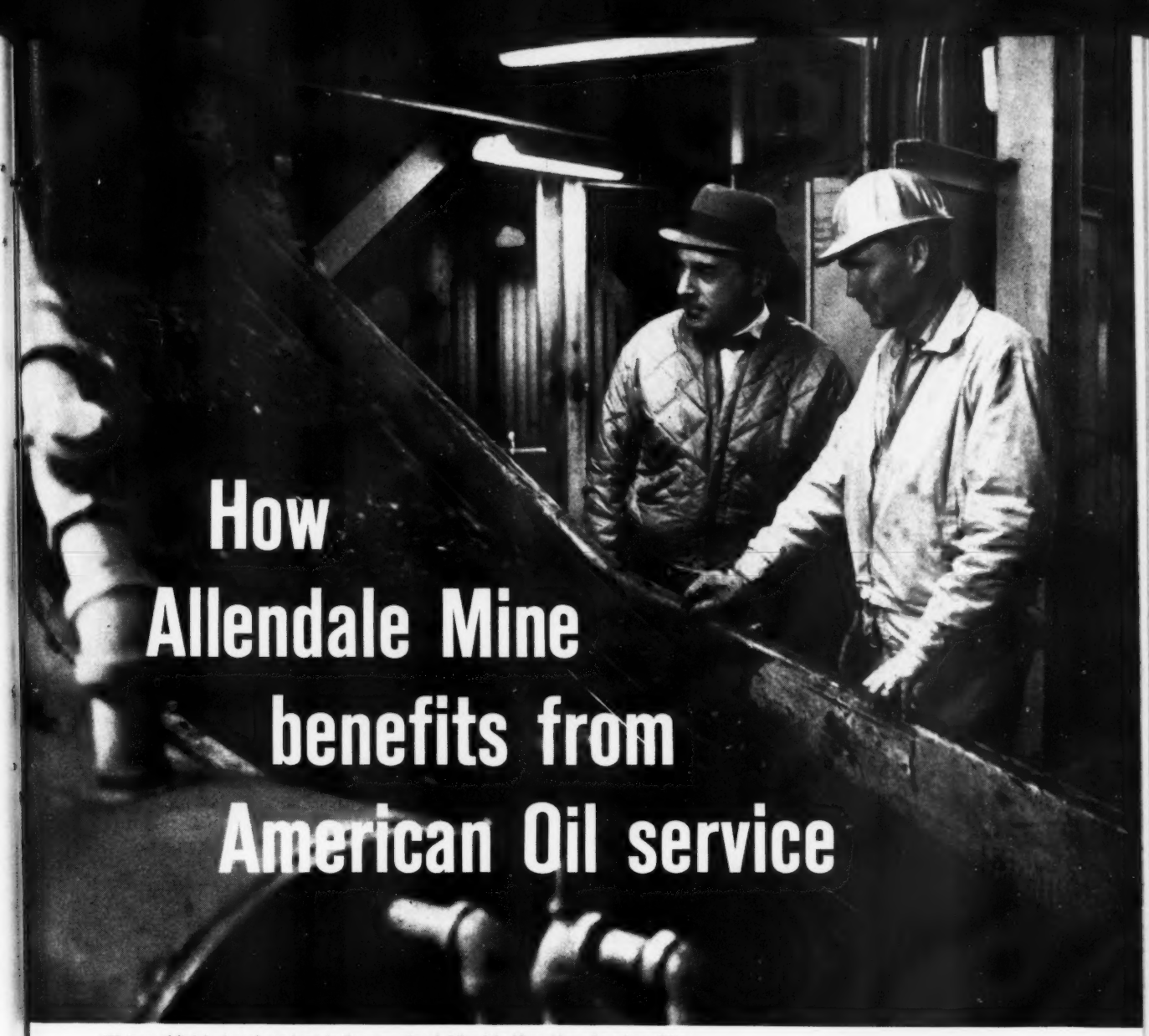

How Allendale Mine benefits from American Oil service

455 tons of finished coal per hour is the capacity of Allendale Mine. Here American Oil's Marshall Fox and mine manager Richard McFarland inspect processed coal on its way to loader.

by **MARSHALL FOX.**
About the author.

"Marsh" Fox knows what service means to an industrial customer. He has been providing such service for 10 years. To qualify him for this work, Marsh has a Mechanical Engineering degree from Purdue University. He also has completed his company's Sales Engineering School course.

☆ ☆ ☆

Service to Allendale Mine, Wyoming, Illinois, began the day equipment arrived at the mine site. As each load of equipment came in, we made a lubrication survey of it. We consolidated these surveys into a final recommendation that gave the equipment full lubrication protection while conserving on inventories by using the minimum number of oils and greases.

Our service to Allendale Mine doesn't stop here. Being acquainted with the account since before the mine began operations, makes it possible for me to be familiar with the mine's lubrication requirements. Also, living less than 60 miles away makes it easy for me to get to the mine whenever I'm needed. It's also easy for me to make regular service calls at the mine at least twice a month. In addition, our American Oil agent is located at Wyoming, only three miles from the mine. He makes regular deliveries of petroleum products to the mine and he's ready at any time for additional calls.

Is American Oil service the kind of service that benefits a mine? Allendale Mine superintendent, Dora Sims; mine manager, "Mack" McFarland; master mechanic, Hubert Davis; pit foreman, Tom King; and tipple foreman, Russ Nichols all have had experience with American Oil service at other Stonefort Coal Mining Company mines. They say, yes, a mine *does* benefit from American Oil service.

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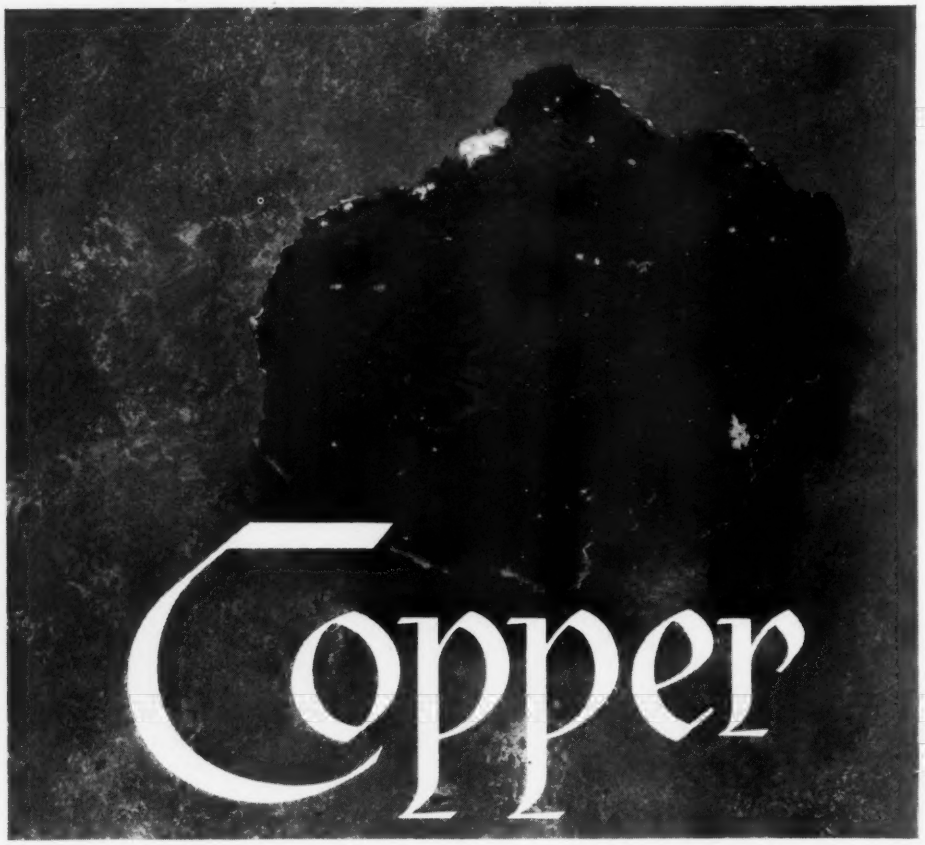
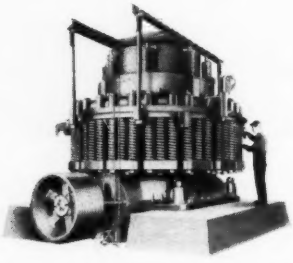


. . . symbol of money and power

The name *copper* is from the Greek κυπρος, Cyprus, one of the early sources of the metal. Copper has often been called "the common man's gold"—and has become a symbol of *money* due to its wide usage in the coins of many nations, as well as a symbol of *power*—since the greatest usage of copper has been as a conductor of electricity.

While native copper is the only metal found abundantly in nature, commercial production is supplied chiefly from various ores of copper, including chalcopyrite, chalcocite, cuprite and malachite.

Wherever these copper ores are processed—in Arizona, Chile, or the Belgian Congo—you'll find Symons Cone Crushers the leading choice among the world's prominent producers. For in copper . . . *as in all of the important ore and mineral operations around the world* . . . Symons Cone Crushers have consistently maintained their prominent position by efficiently processing large tonnages of finely crushed product at low cost.



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This 21000-powered Bucyrus-Erie dragline is swinging a 3-yd bucket on a stripping operation south of Seagoville, Texas.

H. GLENN BUTLER

CLARK FINDLEY

"20% more production on 40% less fuel with our Allis-Chalmers 21000 diesel"

. . . says Butler-Findley Co.

Repowering a Bucyrus-Erie 54-B dragline with an Allis-Chalmers 21000 diesel boosted stripping operations 20 percent for Butler-Findley Co., Dallas, according to Clark Findley, superintendent and production manager. "This engine has given a good old machine new life and stamina," said Mr. Findley.

H. Glenn Butler adds, "Not only that, we are realizing fuel savings of over 40 percent! The 21000 uses less than 5 gal. per hour compared with over 8 gal. for engines in our other machines of the same capacity. We get more work done with much less operation expense, which means dollars to us."

If you want to boost production and save money doing it, talk to your dealer about powering with a modern Allis-Chalmers diesel. Allis-Chalmers, Milwaukee 1, Wisconsin. BC-35

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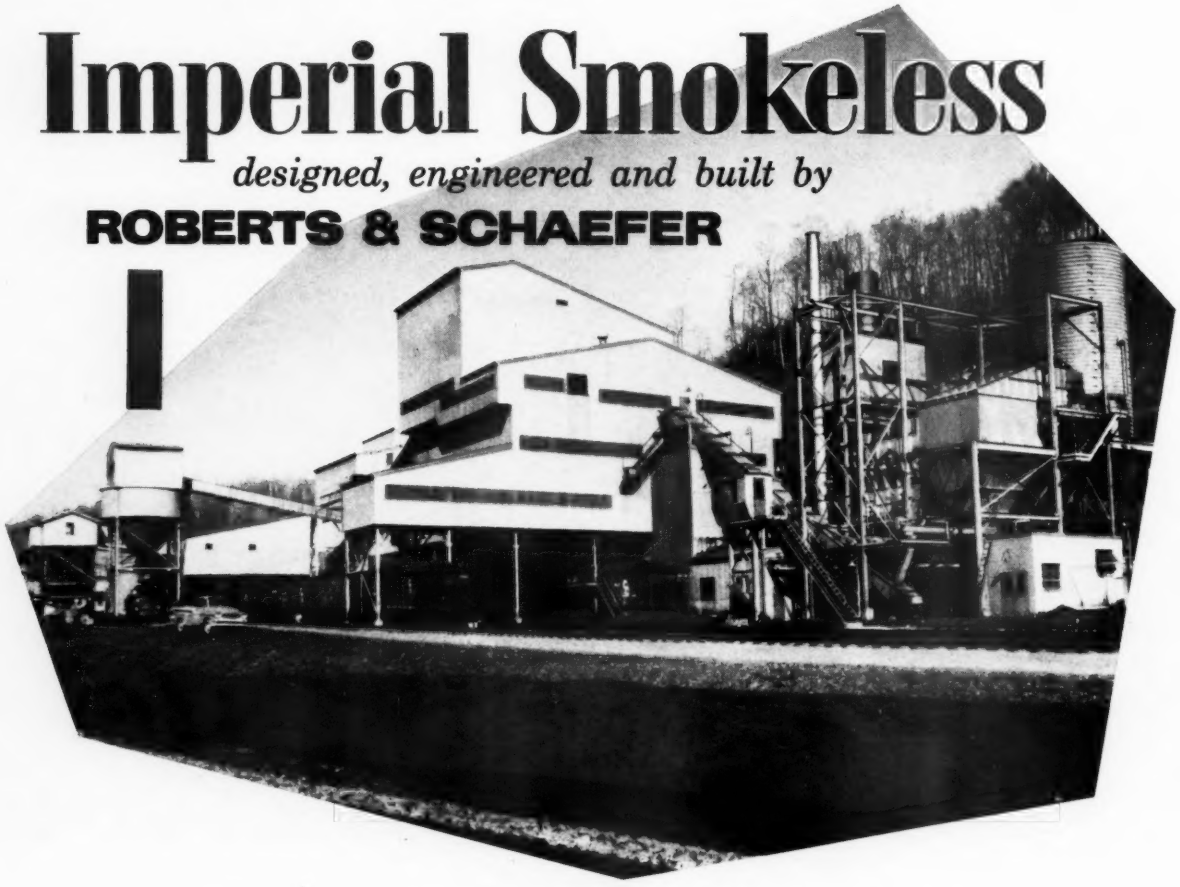

New Preparation Plant, Quinwood, West Virginia

processing Sewell Seam Coal from Nos. 2, 6 and 7 Mines

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"Design and build for us a preparation plant that will produce the highest quality metallurgical coal in America." This was the goal of Imperial Smokeless management when Robert & Schaefer was assigned the responsibility for design and construction of the Quinwood preparation plant.

Mission accomplished!

The ultra-modern, highly automated Quinwood plant, in operation for six months, is successfully producing metallurgical coal with a maximum ash of 2½% in all sizes.

The industry's most advanced coal preparation facilities were engineered into a system designed to obtain the maximum potential in yield and quality from the famous Sewell Seam of exceptionally uniform coking coal.

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Why Gaspe Copper Mines, Ltd.

uses LW Haulpak® trucks

Take this pictorial "trip" to Gaspe Copper Mines' operation near Murdochville, Quebec, Canada, and you'll see why the firm has added another LeTourneau-Westinghouse 27-ton Haulpak to its original pair.

Here, you see loading action at the Gaspe Copper's open pit on top of Needle Mountain. Rock is highly-siliceous limestone ... so hard and abrasive, it wears out drill bits in only 300 feet. Rock like this is damaging to ordinary truck bodies, but Haulpak's 100,000 psi-yield floor resists dents and abrasions. And look at the extra load-capacity Gaspe Copper gets within Haulpak's 10′10″ wheelbase. Deep V-body carries up to 8 tons of material *below* normal floor line ... gives Haulpak exceptional stability on turns and slopes, too.

On hauling operation, Gaspe Copper's 335-hp LW Haulpaks work 19½ hours a day ... haul an average of 26 tons per trip! Tough on operators and tires? *Not with Haulpak.* LW trucks have exclusive Hydrair® suspension front and rear that cushions load and road shocks, protects tires, keeps load riding level. And because Hydrair eliminates springs and front-axle, maintenance costs are reduced.

At spoil bank, flat body floor with no "kick-up" at back gives fast, clean dump. Notice, too, how 3-stage hoists are inverted, shed abrasive dust and dirt. Haulpak's short 44′6″ turn radius permits fast spotting at dump and shovel ... quick maneuvering in restricted underground quarters. Overall Haulpak performance? *"Very good,"* reports Production Engineer Mr. Taschereau.

Let us show you how LW Haulpaks will step-up YOUR hauling efficiency for lowest net cost per ton-mile. Five end-dump sizes, 22 to 65 tons, up to 600 hp. 90-ton bottom dump also available. Ask for details and demonstration.

HP-2482-MQJ-2

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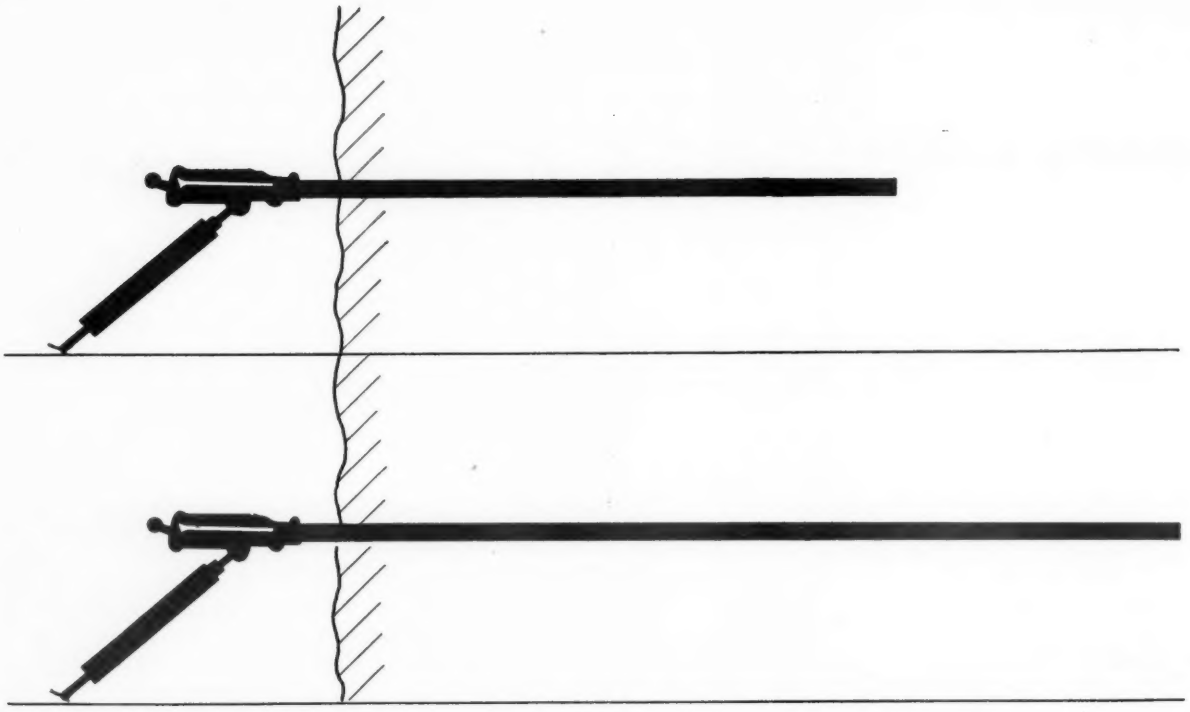

It's the hole truth... 50% FASTER

Never before in the history of rock drilling has there been a feed-leg drill that could do so much, so easily, as Ingersoll-Rand's new JR-300 Universal Jackdrill. On performance alone, it is 40 to 60% faster than preceding models.

The JR-300 is a lightweight, completely integrated rock drill and flexible air-feed leg unit designed for faster, easier drilling in any position. Three feed legs are available with this new machine: conventional single-acting, telescopic and a new double-acting automatically retractable feed leg. All controls are conveniently grouped on the backhead and the feed handle has a two-position button for feed release or leg retraction which reduces steel changing time and speeds setups.

The same fine performance and design features are available in the new R-300 Stoper and J-300 Jackhamer, simplifying parts inventory where all three types of machines are used.

NEW JR-300 JACKDRILL.

Ingersoll-Rand
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Editorial

MINING CONGRESS JOURNAL
ROBERT W. VAN EVERA, Editor
December 1961

Greetings of the Season

Reflecting on the traditional joy of this time of the year, and on man's hope for greater happiness and security in the months and years to come, Mining Congress Journal adds its voice to the chorus of greetings now being exchanged around the earth.

The American Mining Congress traditionally focuses its activities on the serious business of advancing the American mining industry. Along with this, we recognize that good will among men forms the basic foundation for a better world. So we pause for a moment—to extend to our readers, to the entire mining industry, and to all mankind the most human and joyous wish we know. . . .

Merry Christmas—and Happy New Year!

By R. E. HALLBAUER
Mine Superintendent
Craigmont Mines Limited

Mining at Craigmont

New copper producer to exploit ore body by both open pit and underground methods

THE Craigmont mine is situated near the town of Merritt, B. C., 240 miles northeast of Vancouver. The location is very favorable from the point of view of transportation, power and communication. The area is served by paved roads and by the Canadian Pacific Railroad. Electric power is supplied to the area by the B. C. Power Commission and natural gas by Inland Natural Gas Co.

Unlike a large portion of the Province, the climate is such that year-round operation of an open pit mine is practical. Precipitation averages approximately 14 in. per year and temperatures range from 20° below zero in winter to 100° above in summer.

Claims Covering Ore Body Staked in 1957

The history of the Craigmont mine is relatively short. The key claims covering the ore body were staked in 1954. During 1957, diamond drilling was done on a magnetic anomaly and important copper mineralization was indicated. In July 1958, a decision was made to further explore the ore body from underground. Subsequent underground development and diamond drilling confirmed the results of surface drilling. Early in 1960, a decision was made to bring the property into production.

By the spring of 1960 a contract was let for initial open pit stripping and by November of that year construction of the concentrator and other buildings was started. In the period from June 1960 to March 1961, the contractor removed approximately 1,500,000 cu yd of rock and 2,300,000 cu yd of glacial till. In March 1961, Craigmont open pit equipment was put into operation and additional waste stripping was done until September 1961, when the concentrator was placed in operation.

Principal Ore is Chalcopyrite

Geologically the ore body is a copper-iron deposit lying in the Nicola series of volcanic and sedimentary type rocks, along the southern boundary of a diorite quartz-diorite batholith.

The ore body is in a steep to vertically dipping limestone band bounded by walls of greywacke type rocks (figure 1). The favorable limey zone has been deformed into large scale gently plunging drag folds which, with attendant brecciation, form the ore-bearing structures.

The principal copper mineralization is chalcopyrite associated with magnetite and hematite. The latter comprise approximately 15 percent by weight of the ore body. Continuous mineralization is found over a strike length of approximately 2200 ft with widths up to 310 ft. The known vertical extent of the ore body is 1500 ft.

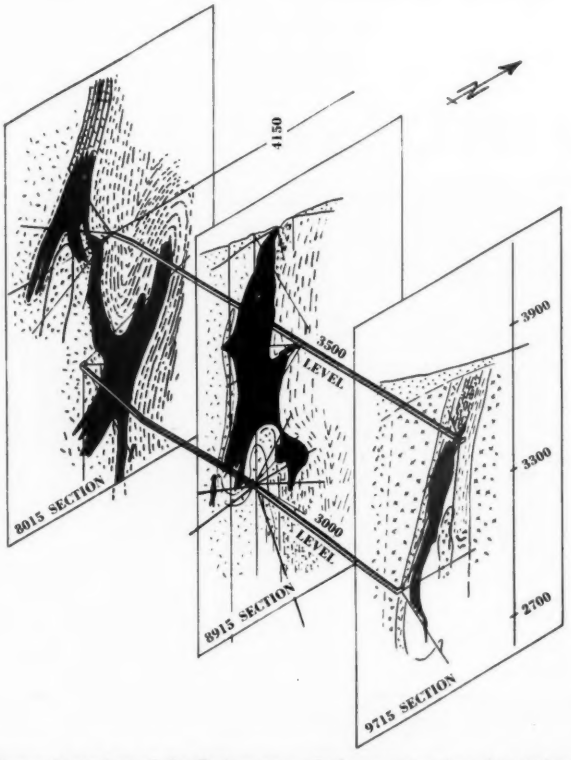


Fig. 1. Isometric sections of the Craigmont ore body—a copper-iron deposit lying in the Nicola series of volcanic and sedimentary type rocks, along the southern boundary of a diorite quartz-diorite batholith

The open pit is located on the east slope of Promontory Hill between elevation 3700 at the east end and 4200 at the west end. The primary crusher, pit shop and pit offices are located at 3700 elevation near the mouth of the pit.

The 4000 tpd concentrator, main office, warehouse, underground change house and machine shop are located at 2400 elevation, some 1300 ft below the mouth of the open pit.

Ore from the open pit is trucked to the primary crusher, a 42 in. gyratory capable of crushing 800 tph to minus five in. The crushed product is conveyed to a 5000-ton, live-load, conical stockpile. From this stockpile the ore is conveyed approximately 300 ft to the cable belt conveyor. This conveyor is a relatively new concept in conveying and the Craigmont installation is the second of its type in North America. The basic difference between conventional conveyors and the cable belt conveyor is the method of transmitting the driving force. In a conventional conveyor it is transmitted by the belt while in a cable belt conveyor it is transmitted by wire ropes. This results in a less costly belt and permits conveying over long distances with a single driving unit.

The 30-in. belt installed at Craigmont is 5600 ft long and has an average grade of 11° and a maximum of 16°, with total a vertical drop of 1121 ft. The belt travels at 300 fpm and has a rated capacity of 370 tph. It is driven by a 370-hp motor which regenerates sufficient power to run the primary crusher.

From the discharge of the cable belt, the ore is placed on a 10,000-ton live-load stockpile by a radial stacking conveyor. Ore is fed directly from this stockpile to the secondary crusher and thence to the 10,000-ton fine ore bins at the mill. Total live storage between the open pit and the mill is 24,000 tons.

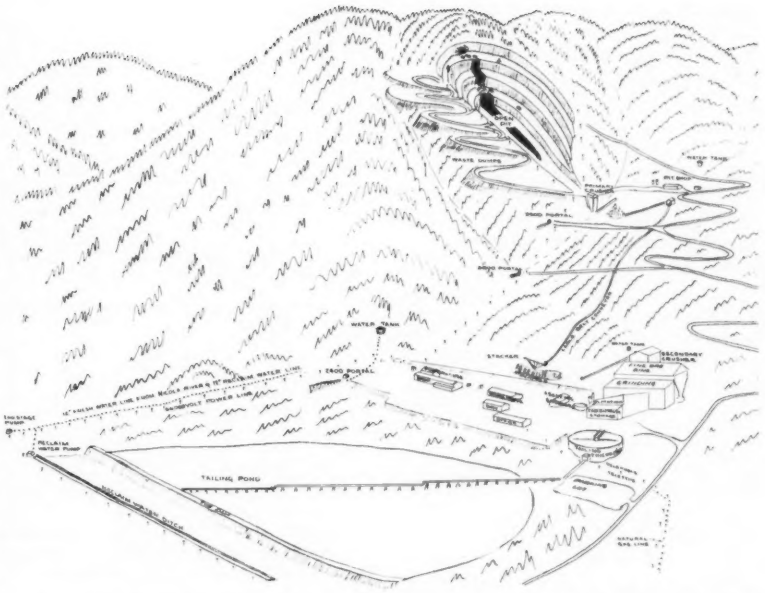


Fig. 2. The open pit is located on a hill between elevation 3700 at the east end and 4200 at the west end. Ore is trucked to the primary crusher at elevation 3700, from which it moves by conveyors to the concentrator at elevation 2400

Open Pit Ore Carries 1.8 Percent Copper

During the spring of 1959 preliminary planning indicated that, although the ore body would be mined primarily from underground, there was a possibility of open-pitting the upper portion. Until this time, most diamond drilling was directed to determining the downward extent of the ore and little information existed on the area within 200 ft of surface. To permit visual examination of the surface outcrop and to simplify diamond drilling, 100,000 yd of overburden were removed from a trench directly over the ore zone. Diamond drilling was done in the fall of 1959 and results indicated that although the ore body was weak on surface, it strengthened quickly with depth.

With this information, studies on the economics of open pit versus underground mining were started. These studies indicated that at least the portion of the ore body above 3500 elevation could be mined most economically by open pit methods. Many alternative pit designs were considered with the principal variables in these designs being (1) tonnage of ore to be mined per year, (2) grade of ore to be mined in each year, (3) quantity of stripping and stockpiling to be done during preproduction, (4) mill cut-off grade and stockpile grades. A cash flow for the full life of the open pit was prepared for each alternative, and by using a variation of the Hoskold formula, the present value of the profit from each was determined. By this means an over-all production schedule was planned.

To produce the maximum profit from the open pit, it was established that the east end of the pit must be deepened rapidly during the first

Present plans call for mining about 8,000,000 tons of 1.8 percent copper ore by open pit methods with a waste to ore ratio of 4.68 to 1

year. That is, rather than work the whole strike length of the ore body, only the east end is worked initially. Ore in the west end is recovered during later years when the west wall is pushed back. These alternative methods of mining the pit are illustrated in figures 3 and 4.

The difference in grade realized by adopting the plan illustrated in figure 4 is as follows:

Year 1 — increased by	0.35% Cu
Year 2 — increased by	0.52% Cu
Year 3 — *decreased* by	0.39% Cu
Averaged for three years, grade increased by	0.18% Cu

This difference in ore grade results in an important difference, both in total earnings during the first three years of operation and in recovery of capital investment.

Under the present mining plan, the total quantity of ore to be mined by open pit methods is approximately 8,000,000 tons grading 1.8 percent copper. The waste ore ratio for this quantity is 4.68 to 1.

Initially production will be supplied entirely by the open pit, but during the latter part of the first year of operation, ore production from underground will commence on a minor scale. Underground production will gradually assume more importance and when open pit reserves are exhausted, all production will come from underground.

Pit is Open at One End

A tour of open pit operations in Minnesota, Montana, Arizona, and Utah was made by company engineers, and the information gained on this trip was invaluable in planning the Craigmont pit and in selecting the equipment.

Due to the nature of the terrain and the strike of the ore zone, it was possible to design the pit in the shape of a horseshoe with one end open over a vertical distance of 700 ft (figure 5). Because of the short length of the pit and the large difference in elevation between the upper benches and the crusher, an external haul road system was designed. As the terrain on the south side of the pit offered a large waste disposal area, the haul roads were constructed on this side. Roads leave the pit at 66 ft vertical intervals. Once outside the pit, they split to form a waste haul road which proceeds flat to the waste dump and an ore haul road which proceeds at minus eight percent to the crusher.

Working benches are 33 ft high and on reaching final pit limits, two

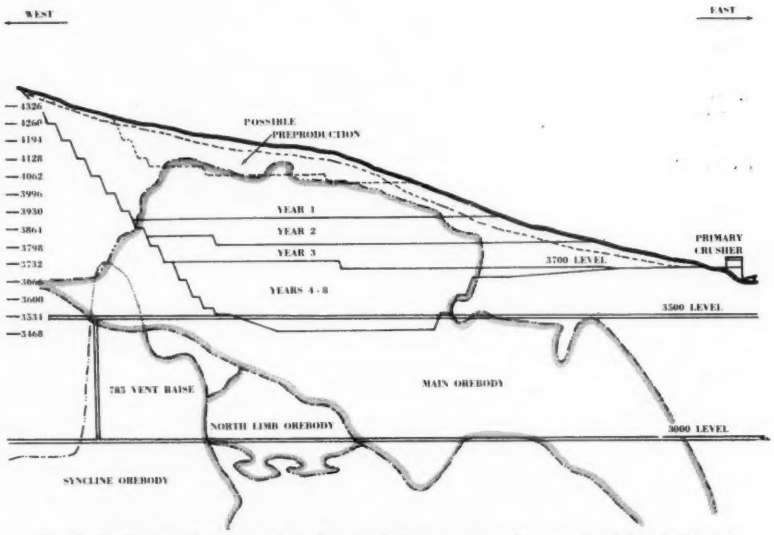


Fig. 3. Studies on the economics of open-pitting versus underground mining indicated that ore above 3500 elevation could be mined most economically by open pit methods. One of the alternative schedules of mining is shown in this longitudinal section

benches are consolidated to leave a 66-ft bench. The berm width is 30 ft and the slope of the face is kept at 70° to comply with Provincial Mining Laws. This combination produces an over-all wall slope of 51°. This slope is currently in use on the west and north walls. To provide access to the west wall for future pushbacks, a 50-ft berm is left on each bench on the south wall of the pit. This berm width results in an over-all wall slope of 41° (figure 6). Whether or not the over-all slope of 51° can be maintained has yet to be determined. If this wall slope proves to be unstable, it will be altered when a pushback of the west wall is made in two years. To date, some minor sloughing has occurred but wall conditions are generally satisfactory.

Shovels and Drills Operate on 4160 Volts

Power is conducted at 4160 volts from the main substation at 2400 Level to the open pit. Near the mouth of the pit the line is divided to provide power on both the north and south sides of the pit.

Shovels and drills are electrically powered and operate on 4160 volts, thereby eliminating all transformers between the main distribution center at 2400 Level and the equipment.

Trail cables contain six conductors with three wires for power, two ground wires and one pilot wire. Switch houses are designed to kick out whenever the pilot circuit is open. If a cable is disconnected from a machine or from a plug, the switch house automatically kicks out and the switch cannot be closed until the pilot circuit is restored.

Cable lengths of 500 and 1000 ft are used. Plugs and connection boxes are designed so that both ends of a length of trail cable have male fittings. This simplifies cable handling in that either end of the cable can be attached to the equipment.

Two drills are currently in use for primary breaking; a nine in. crawler-mounted rotary drill and a six in. crawler-mounted down-the-hole drill.

Although it was known from drillability tests and later from the contractors' experience that much of the rock could be drilled economically by rotary drilling, there was some doubt as to the economics in ore and other hard formations. As two drills were needed, it was decided to purchase a rotary outright and to obtain a down-the-hole drill on a trial basis. During a five-month test through July 1960, it was established that the rotary is capable of drilling the majority of the rock found in the Craigmont pit more economically than the down-the-hole drill. The following table gives performance figures for the two drills:

	Rotary Drill	*Down-the-hole Drill*
Feet per drill shift	275	212
Tons per drill shift	12,000	5,100
Bit life, feet	1,200 (steel bits)	5,000 (tungsten carbide)
Availability, percent	93.5	92
Total tons broken	2,269,550	962,955

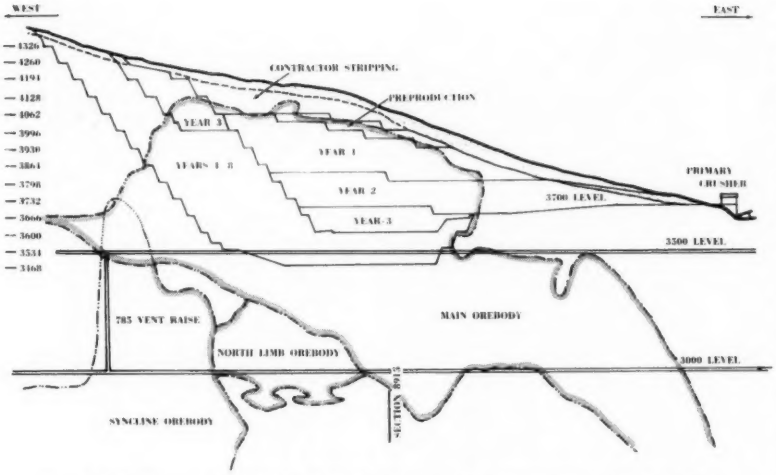


Fig. 4. Adoption of the mining plan shown will result in maximum earnings during the first three years of the operation and have an important effect on recovery of capital investment

Drill hole spacing has been varied but best results to date with nine-in. holes have been achieved with 25 ft by 25 ft spacing in waste and 15 ft by 18 ft spacing in ore. Best results with six-in. holes have come from 18 ft by 18 ft spacing in waste and a 10 ft by 13 ft spacing in ore.

Holes are drilled to a depth of 38 ft to provide five ft of hole below bench grade. In some areas where ground is extremely soft and caves readily, holes have to be drilled to depths of 50 ft to realize 38 ft of open hole.

Variations in Iron Content Affect Breakage

Two main blasting agents are used: ammonium nitrate mixed with fuel oil and Hydromex, a commercially mixed slurry. The AN fuel oil mixture is used in dry holes, while the slurry is used in wet holes and in varying portions in ore blasts.

Oil is added to the AN bags directly from the fuel truck and bags are allowed to soak for at least 48 hours. Prepared bags are distributed to the holes by the blasting truck.

All blasts are detonated with Primacord and 135-grain primers. When holes are dry, a single Primacord downline is used, while in wet holes a double line is used. The double line is used in wet holes as the detonating fuse is frequently damaged while forcing the bags of slurry down the hole. Detonation of the Primacord is by millisecond delay caps taped to it.

Waste rock is badly fractured and can be classed as easy breaking; very little secondary blasting is required. Initially 50 lb of the commercial slurry was used in the bottom of the holes to aid in shearing of the toe, but experimentation proved that results were satisfactory with holes loaded entirely with AN. The average powder factor for waste rock is 0.3 lb per ton.

The ore is much harder and denser than the waste rock and is considerably more difficult to break, particularly in sections where the iron content is high. To date considerable secondary blasting has been required, but much experimentation on hole spacing and powder factor remains to be done. It is felt that results can be improved considerably once ore is handled in sufficient quantity to make further testing possible. To date the powder factor in ore blasts ranges between 0.37 and 0.45 lb per ton.

Trucks Have Automatic Transmissions

Three 4½-yd electric shovels are used to dig both ore and waste. At

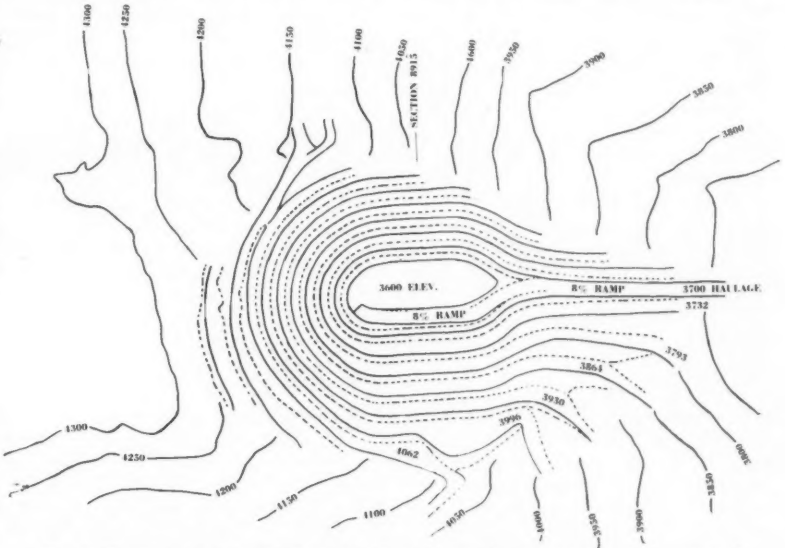


Fig. 5. The open pit is in the shape of a horseshoe with one end open over a vertical distance of 700 ft. Haul roads leave the pit on the south side at 66-ft vertical intervals with waste going to the dump and ore being transported to the crusher

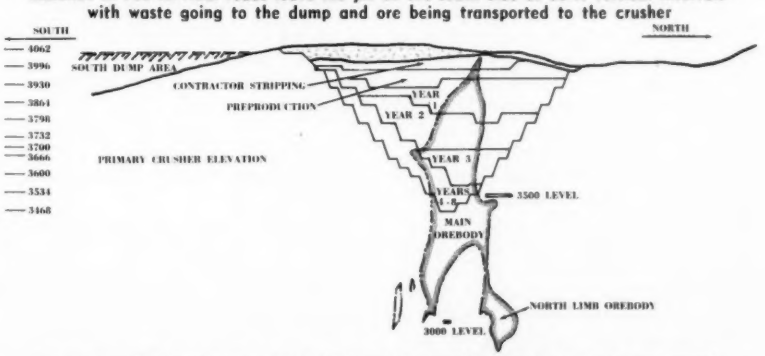


Fig. 6. Working benches are 33-ft high and on reaching final pit limits are consolidated to leave a 66-ft bench; the over-all wall slope in the mine will be 51°

present the pit is operated two shifts per day with five shovel shifts per day scheduled.

Ore is handled on day-shift with one shovel while the other shovels are employed on waste stripping on both shifts. Scheduled tonnage is 6000 tpd of ore and 26,000 tpd of waste and stockpile material.

Except where insufficient room exists, for example in pioneering a new bench, all loading is done with trucks on both sides of the shovel.

Experienced electric shovel operators are very scarce in western Canada. Out of five operators now employed, two were experienced on electric shovels, one was an experienced 2½-yd diesel shovel operator and two were totally inexperienced.

Average shovel performance for the first five months of operation, including the time required for operator training and all lost time, equalled 6071 tons per eight-hour shift. To date utilization of shovels has been 90.3 percent and availability has been 97.5 percent. The remaining lost time is distributed as follows: Moving, 3.8 percent; electrical failure, 1.6 percent; and waiting, 1.8 percent.

The total tons loaded by the three shovels during the five months from March through July amounted to 3,191,000 tons.

All ore and waste is removed from the pit by 14 diesel-powered 27-ton trucks equipped with automatic transmissions and Torqmatic brakes. The Torqmatic brake has proved to be a very desirable feature on the downhill ore haul and on short steep ramps within the pit.

The only feature on the trucks that is not standard is the construction of the boxes. Due to the abrasiveness of both the ore and waste, it was decided to construct them from T1 steel. Bottom and front liners are ¾ in. thick and side liners are ⅝ in. thick. Wear bars are not installed and the boxes are not heated. To date, although tonnages handled have not been large, there is no noticeable wear and there is no denting in any of the boxes. Up until the end of July, the maximum tonnage handled by any one truck was 290,000 tons.

All trucks are identical with the exception of the air filters. After discussing the pros and cons of dry filters versus wet filters with many operators, it was decided to equip seven trucks with wet filters and seven with dry filters, in an attempt to determine which were the most efficient and economical. To date the cost of maintaining the dry filters has been considerably less than for the wet, but too few hours of operation have been amassed to form any definite conclusions.

To provide an efficient loading cycle either three or four trucks per shovel are used on waste hauls and four or five trucks per shovel on ore hauls. At present the length of waste hauls varies considerably but would average approximately 5000 ft return. The average length of the ore haul is 3400 ft return but this distance will decrease as the pit is deepened.

Trucking performance for the first five months of operation is summarized below:

Total tons hauled	3,191,085
Tons per truck shift	1,764
Percent utilization	94.9
Tons per load, waste	29
Tons per load, ore	31

Mobile Fuel and Grease Truck Services Pit Equipment

Three bulldozers are currently in use for road construction, shovel cleanup and dump maintenance. Two of these are crawler-type and the third is rubber-tired. The rubber-tired machine is used almost exclusively for shovel cleanup.

As trucks dump directly over the edge of the dump, the main duty of the dump tractor is to keep the dumps level and to ensure that a protective ridge is maintained at the edge. The ridge is kept approximately three ft high, thereby providing a back-stop for trucks. To date this practice has proven to be very effective.

One road grader and one 3000 gal water truck are on continuous road patrol. To date no treatment of road surface has been attempted.

The open pit shop is located at 3700 elevation, approximately 500 ft from the primary crusher. The shop was designed under the premise that all major overhauls on engines, transmissions and rear ends would be done in Vancouver. Spare units are carried on the property and when a major breakdown occurs or a major overhaul is due, the units will be exchanged. This policy was adopted because the special equipment and special training required for mechanics was not considered to be warranted for the number of units on the property.

The shop is an all-steel building measuring 163 ft by 66 ft and contains the pit office and change house. The shop itself contains one grease bay and four repair bays.

A mobile fuel and grease truck is used to service equipment in the pit. It carries 500 gal of fuel, six different types of lubricants, and air-powered pumps for dispensing them. To keep an accurate account of fuel and lubricant distribution, all dispensers are equipped with totalizing meters. The entire unit is housed in a propane-heated van body. An I-beam track and a ½-ton trolley and hoist are permanently mounted in the van to simplify unloading of lubricant containers.

A repair truck is used for transporting mechanics and equipment for field repairs on shovels and drills. It is equipped with a three-ton hydraulic crane, an air compressor and oxy-acetyline welding and cutting equipment.

The total number of men in the pit shop is 24.

Ultimate Pit Depth Yet to be Determined

Supervision in the pit on day shifts consists of a general pit foreman, shift foreman, and shift boss. A shift foreman and shift boss supervise the afternoon shift. A total of 53 days pay employes work in the open pit.

As mentioned previously, experienced shovel operators were difficult to obtain in the area. This situation was also true with rotary drill runners, down-the-hole drillers, blasters and to some extent, truck drivers. It was therefore decided to train as many operators as possible. This program has been very successful and many local residents have been hired.

Engineering and geological control are provided by a pit engineer and pit geologist working full time. Planning is done on a yearly, monthly and weekly basis. Grade control is provided by sampling all blastholes and geological mapping of benches.

A two-man survey crew is employed full-time in the pit. All blastholes are laid out in the field by the surveyors and all holes in low grade and ore are surveyed after drilling. Bench faces are picked up at least once a week and oftener if required.

Results to date have confirmed that open pit mining of the upper portion of the ore body will be successful. Two factors as yet unproven are the maximum over-all wall slope that can be maintained and the maximum depth to which the pit can be mined. The latter factor depends primarily on the mining costs that can be realized underground as compared to open pit mining costs. When sufficient underground mining has been done to establish recoveries and costs, the depth to which the pit can be taken economically will be determined.

Shooting With Air in Low Coal

A new drilling and air shooting machine has cut the mining cycle time and reduced preparation costs

By J. L. McQUADE,
Senior Executive Vice President
Maust Coal & Coke Corp.

Air shooting decreased the amount of minus ¼ in. coal and increased the amount of coarser sizes, reducing the load on the cleaning plant

THE Tioga mine of Maust Coal & Coke Corp. is located in Nicholas County, W. Va., in the Tioga seam. Tioga coal is of high quality, metallurgical grade and the seam height varies from 38 in. to 52 in.

In 1946 Cardox was introduced for breaking coal at the face to increase the percentage of coarse coal in the mine's production. Cardox, which utilizes liquid carbon dioxide as the charging agent, was used until 1953 when it was replaced by the Airdox system. The Airdox system requires a series of air compressors capable of developing 10,000 or more psi; steel air lines with an outside diameter of one in. and inside diameter of ⅝ in. are used to conduct the air into the mine and to the working sections; flexible copper tubing with ⅜ in. outside diameter and 7/40 in. inside diameter carry the air from the steel lines to the working faces; and reusable steel Airdox tubes are used in the drill holes.

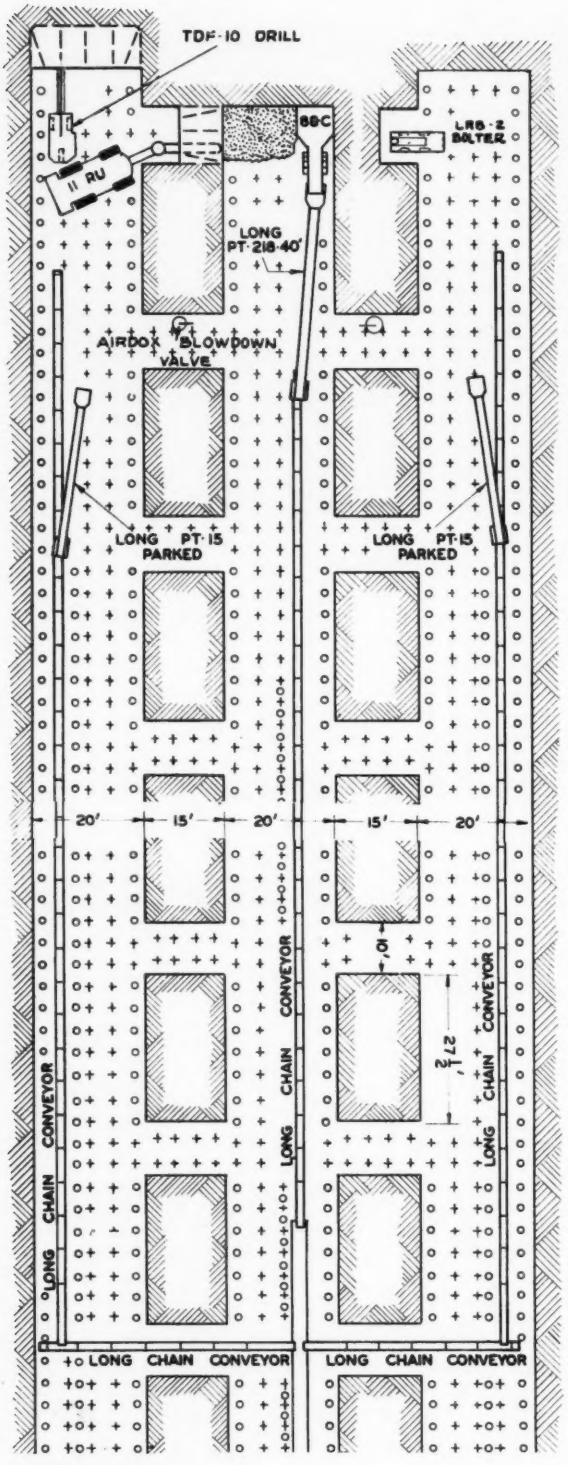
Air rather than permissible explosives are used for the following reasons. Large size coal is easier to clean and an improved product was the result and the capacity of the preparation plant was increased resulting in a saving in labor. There are other reasons for using air, such as the problem of theft of explosives, the cost of transporting explosives and the offensive smoke made by explosives.

In 1950 loading machines were installed at Tioga along with Piggybacks and rubber-tired cutting machines. These improvements increased productivity, but brought about a need for an improvement in shooting methods.

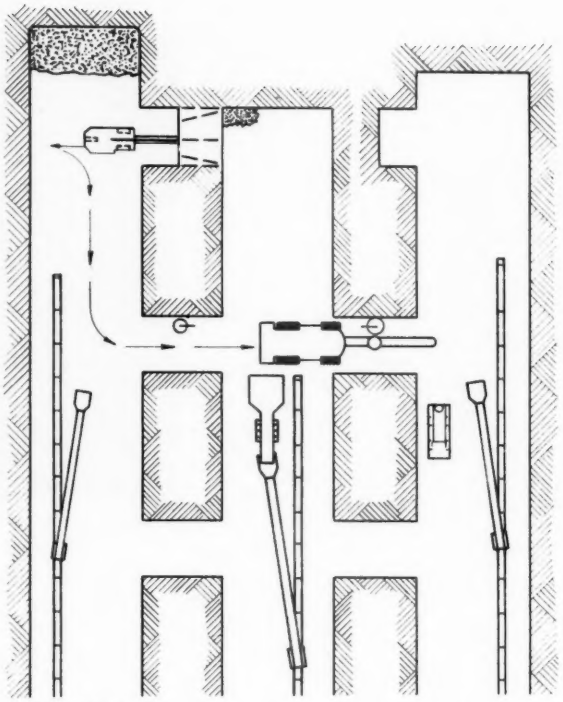
With the method of air shooting in use at that time it was necessary that one hole in the face be discharged at a time, and it was impossible to achieve a balanced cycle. The shotfirer was required to crawl back and forth to the blowdown valve for discharging the tube in each hole. Another handicap was the difficulty of transporting the tubes by hand from place to place. A typical time for shooting one hole was two minutes, and there were ten holes per place. Additional time was required to manually carry the tubes, sequence, valves, etc., from place to place. The method did not fit into a fast mining cycle.

The mining pace was set by the loading-machine, bridge-conveyor combination which produced an extremely fast loading cycle. Rubber-tired cutting machines, face drills, and roof bolters provided the required cycle time in their respective departments. In an attempt to balance the mining cycle air shooting was discontinued and experiments were conducted with various methods of powder shooting.

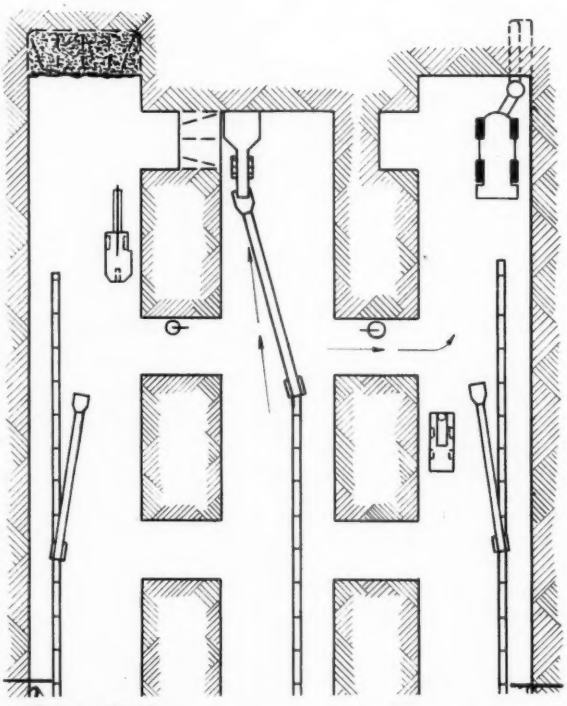
Powder shooting also had its time limitation in the mining cycle and did not produce the desired product. Ash percentage went up—coarse coal percentage came down—the cleaning plant was overburdened with an increase of fines and cleaning costs increased.



Sequence No. 1
Drilling, cutting and shooting is performed in left entry while loader operates center entry
Note: Timber and roof bolts are on four-ft centers
0—Indicates timbers
+—Indicates roof bolts



Sequence No. 2
The drill operates in left entry while the cutter trams to the right entry, the conveyor tailpiece is kept back of the last open breakthrough



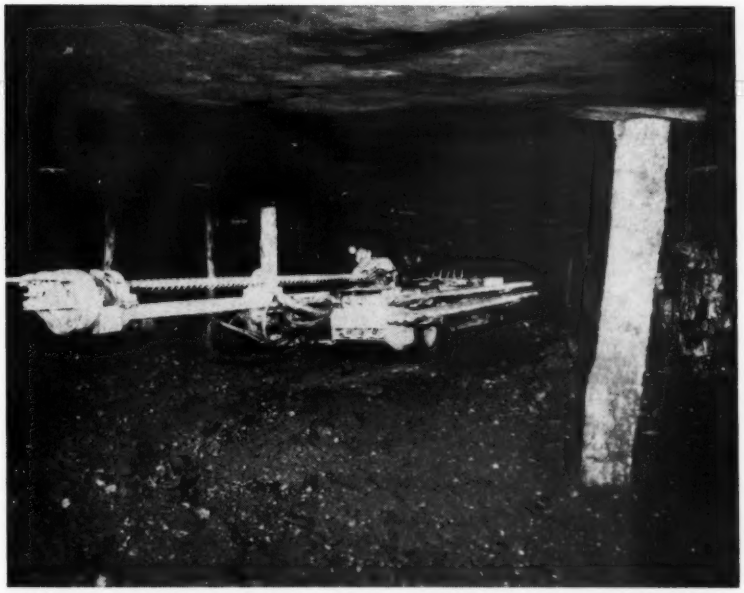
Sequence No. 3
Loading is performed in center entry and the cutter operates in right entry

Below is a comparison in the size consist of powder shot coal and Airdox prepared coal.

Size	*Percentage with Explosives*	*Percentage with Airdox*
Plus 4 in.	5.52	12.03
2 by 4 in.	5.92	7.52
1½ by 2 in.	8.98	10.17
¼ by 1½ in.	17.72	16.13
Minus ¼ in.	61.86	54.15

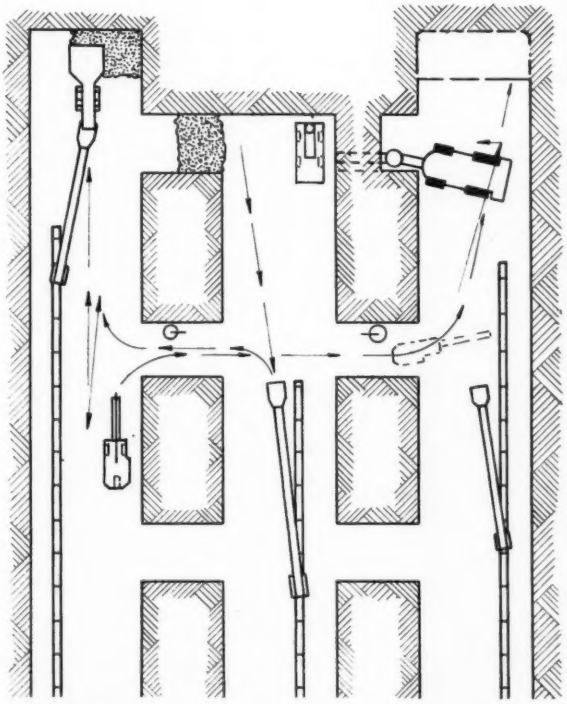
One Man Drilling and Shooting Machine Developed

In early 1960 a self-tramming, one-man drilling and Airdox multiple shooting machine was developed. This unit combines a high speed mobile face drill and the latest shooting equipment. Modification of the new machine, including sequence shooting valves and automatic discharge tubes, allows a group of tubes to be discharged automatically with only one trip of the shotfirer to the blowdown valve. A trial machine was installed on one section. The sequence valves were mounted on the machine and racks were provided for transporting the air tubes. The drilling-shooting machine eliminated the manual transporting of tubes and the sequence valves eliminated the frequent trips to the blowdown valve. One man is able to drill and shoot and stay ahead of other phases of the mining cycle. After a trial period, the machine was accepted and the balance of the sections were equipped with similar units.

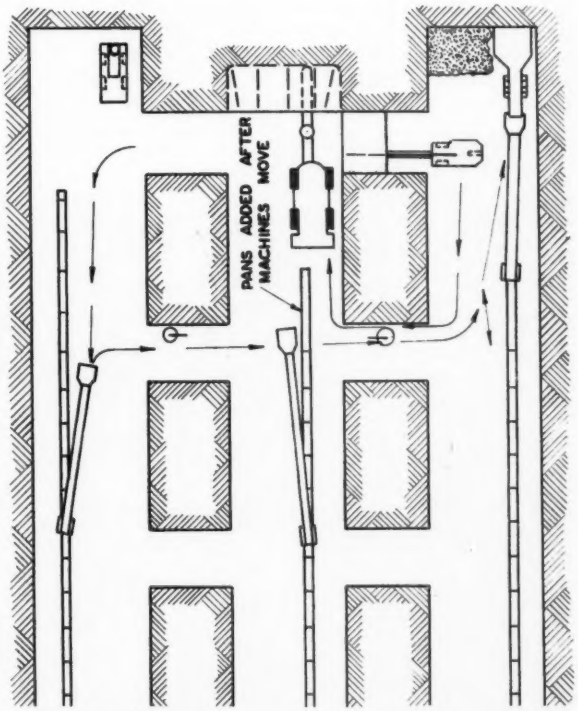


New, one-man, drilling and air shooting machine trams from place to place carrying all necessary equipment

The new machine will drill holes 11 ft deep and carries all necessary face equipment. Five-ft air tubes, each equipped with an automatic discharge head, are carried on the machine in racks. These racks may be mounted either on top of the machine or on the side of the machine, depend-



Sequence No. 4
Loading is performed in left entry and the cutter operates in right entry



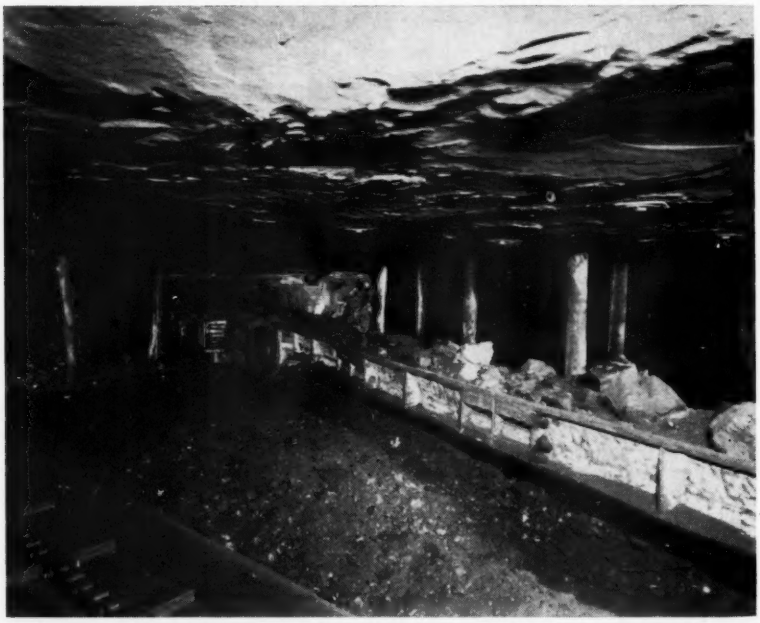
Sequence No. 5
Loader operates in right entry as cutter operates in center entry

Undercut with a universal rubber-tired machine having a nine-ft cutter bar, the 30 ft wide face contains ten nine-ft drill holes

ing on height requirements. These racks contain the shells and the permanently attached flexible rubber shooting hoses. Hoses are 25 to 50 ft long, depending on requirements, and are attached to the back end of the discharge tubes on one end and to a group of automatic sequence valves on the other. The sequence valves are also mounted on the machine. Air (9000 to 10,000 psi) is fed to the sequence valves on the machine from the blowdown valve by another flexible air hose also carried on the machine.

The Airdox equipment consists of five air compressors installed on the outside in a separate building near the main portal. These units deliver air to a steel pipeline which carries the air to a point approximately 150 ft from the working face.

The steel air line is carried in the center heading and is advanced as the faces advance, generally on the third shift. This is not a difficult or time consuming task and can be done between shifts if necessary. A semi-flexible copper line carries the air from the steel line to the blowdown valves.



A cut of coal in a 30 ft room contains 35 tons of coal and is loaded out in 17 minutes

Combined Drilling and Shooting Time Reduced 15 Minutes

The drilling and shooting machine trams through the breakthroughs into the face area and begins drilling on the left-hand side of the face.

Ten holes, each nine ft deep, are drilled in each 30-ft wide face. This compares to seven holes in places previously shot with powder. The additional drilling capacity of the drilling-shooting machine, combined with increased shooting capacity resulting from use of sequence valves and automatic discharge tubes, permits shooting the additional holes for better loadability. These extra holes are shot at no extra cost other than a small amount of bit wear. After the holes are drilled, the operator removes the tubes from the machine and inserts them into the five lower holes. The machine is then backed into a breakthrough, the feeder line attached to the blowdown valve and the lower five holes are shot.

The function of the sequence valves and automatic discharge heads is such that one movement of the blowdown valve will automatically cause all five tubes to shoot, one after another in rapid succession. After the lower holes are discharged the operator returns to the face and inserts the tubes in the upper holes. The upper holes are discharged. The machine is then trammed back to the face and the tubes are loaded onto the machine for tramming to the next place.

The average time required for the complete drilling and shooting cycle is 17.04 minutes.

Tramming into place (average distance 100 ft) . . .	0.65 minutes
Drilling and positioning machine for ten holes . . .	6.89
Removing air tubes from machine and loading lower holes . . .	2.55
Walk to blowdown valve . . .	0.52
Shoot five lower holes . . .	1.25
Return to face and insert tubes in upper holes . . .	1.31
Walk to blowdown valve . . .	0.52
Shoot five upper holes . . .	1.25
Return to face and load tubes and hose on machine . . .	2.10
Total Cycle Time	17.04 minutes

This fast drilling-shooting cycle compares to a cycle time of 32.00 minutes for drilling and shooting when single "shooting," that is discharging one tube at a time.

Other Phases of Mining Cycle Provide Continuous Transportation of Coal

In both heading and room work three places are driven with each section. Panel headings are driven to their required distance of either 2000 or 3000 ft. The equipment is then turned and 30 ft wide rooms are driven parallel to the 20 ft wide headings back toward the main headings. With this method all equipment moves are forward with the exception of one turn around move at the end of the panel heading. Materials are carried with battery-operated utility tractors and trailers. These units are small which allows them to operate in close timbering and restricted space, but at the same time they will haul a man-sized load either on the unit or in trailers.

Driving rooms parallel to the headings allows easy access to the face area by the battery tractor. The outside heading is the runway and supplies are carried from the belt head to the face areas without hindrance or restriction.

Loading equipment consists of a Long-Airdox Model PT-218 Piggyback, or bridge conveyor. Each room or heading is equipped with a 15-in. room chain conveyor, with its drive unit crawler mounted for easy moving, and a bridge conveyor. One Type 88 loading machine trams from place to place connecting and disconnecting from the bridge conveyor in each place. This system provides continuous transportation for all material loaded by the loading machine. The system provides belt transportation in the panel and main headings, coupled with bridge conveyors in the face.

The center place may be crossed with mobile equipment since the conveyor tailpiece is kept back of the last open breakthrough. The piggyback, a specially designed 40-ft unit, is 12 ft longer than those used in the past. With the 40-ft bridge conveyor and the 17-ft loader, the reach is more than 50 ft from the end of the conveyor to the face at all times. With breakthroughs spaced on 37½-ft centers, the mine always has an open breakthrough ahead of the conveyor tailpiece. This simple procedure of leaving a runway open across the face of the center place has been successful and effective.

Cutting is done with a mobile rubber-tired universal type cutting machine equipped with a nine-ft cutter bar giving an effective depth of undercut of 8½ ft.

Roof bolts are installed on four-ft centers with a type LRB roof bolting machine.

A total of nine men are used on each section, distributed as follows:

Loading machine . . .	2
Cutting machine . . .	2*
Roof bolting machine . . .	1
Drilling and shooting machine . . .	1
Utility man . . .	1
Mechanic . . .	1
Foreman . . .	1
Total	9

** Most rubber-tired cutters are operated by one man. The average face working time is 400 minutes per shift and the standard cycle time is 18 minutes. This cycle time results in 22 cuts per shift. The cycle breakdown is as follows: cutting 12 minutes, drilling and shooting 17 minutes, loading 17 minutes and roof bolting 10 minutes.*

The above figures are based on 30 ft wide rooms, 8½ ft depth of undercut, and 3½-ft seam height. Each cut results in approximately 35 tons of material. The cutting and roof bolting crews have time to perform any miscellaneous work required in any section of the mine.

The introduction of the Long-Airdox drilling and multiple shooting machine provides the mine operator with all the advantages of air shooting and the means to accomplish both drilling and shooting with one man within the fast time cycle needed in today's high capacity mining.

SuperDuty® Concentrating Efficiency is No Accident

Decades ago, when the SuperDuty DIAGONAL-DECK® tables were first introduced, there were those who thought their high performance records were accidental and due to simple conditions of feed or studied adjustments.

But as the years rolled on, more and more operators installed SuperDuty tables, to find how easy and uncomplicated it is to get peak performance . . . maximum recovery through higher grade concentrates, leanest tailings, and resultant capacity boosting via minimum middlings for recirculation.

Today, the SuperDuty DIAGONAL-DECK table is generally recognized as a symbol of efficiency and economy. Send for Bulletin 118-C.

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This all steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separations made by each main cell. Advantages offered are: (1) accurate classification or sharp sizing, (2) easy and effective hydraulic water regulation, (3) as many spigot products as there are cells, (4) continuous discharge, (5) no moving parts, (6) low maintenance cost.

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Plant Services Program at Bunker Hill

By LeVERN M. GRIFFITH
Manager Plant Services
The Bunker Hill Co.

Major reorganization eliminated much duplication of effort and facilities and pointed the way to reduced costs

THE Bunker Hill Co. started 76 years ago on September 10 as a prospect. The total capital plant was a pick, a shovel, an axe, a wheelbarrow and a jackass. The one employe was a lonely prospector who had to spend more time looking for a grubstake than he could spend looking for a mine.

Today, Bunker Hill's Kellogg, Idaho, operations consist of two mines, a concentrator, a lead smelter, an electrolytic zinc plant, a sulphuric acid plant and a phosphoric acid plant. In Kellogg the company employs 2200 hourly and salaried workers and the total plant replacement value is close to $60,000,000.

The smelter is one and one-half miles west of the Bunker Hill mine and concentrator, the zinc plant and acid plants are two and one-half miles to the southwest of the mine and concentrator.

Up until 1955 the mine, the smelter and the zinc plant operated almost as three separate companies with each providing and directing all of the services and facilities essential to its operation. Management became alarmed at the very high indirect costs. A detailed comprehensive study of the total operations activities and facilities pointed up the need for correction of duplication of effort and facilities, the poor utilization of specialized talents and machines, and poorly defined responsibilities for costs, or in some cases, significant blocks of costs, unidentified and without responsibility assignment.

This aerial view shows the lead smelter and the electrolytic zinc plant in the canyon to the south. The phosphoric acid plant, which was built after the picture was taken, is also located in the canyon. The mine and concentrator are off the picture to the left 1¼ miles east of the smelter

Reorganization Begun in 1955

A major reorganization of the Kellogg operations was undertaken early in 1955 to mold them into an orderly, integrated organizational unit. A determined special effort was made by many of the staff with the help of consultants to use the latest techniques, methods and systems as they seemed to fit the specific needs of the Bunker Hill Co.

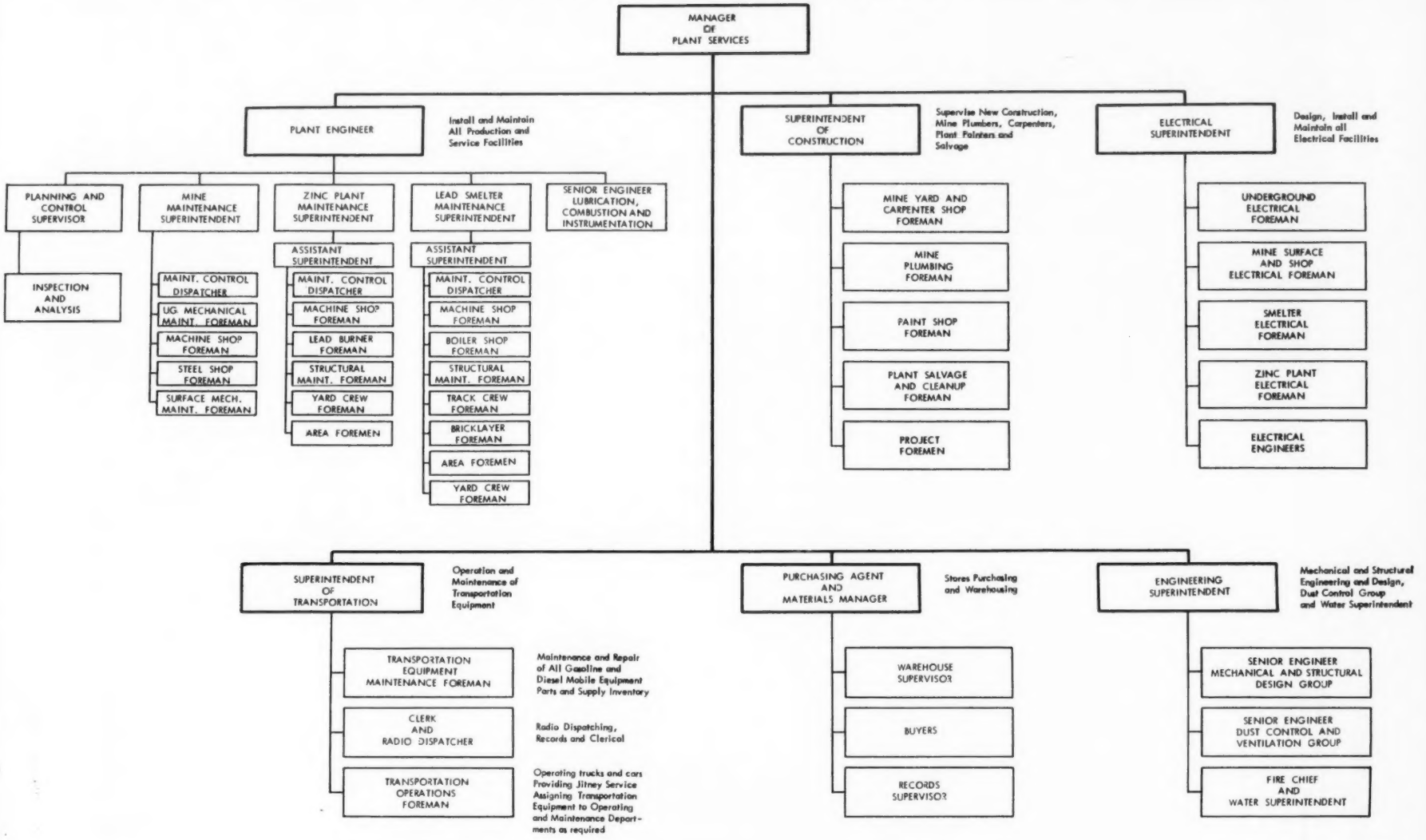
With this reorganization, all of the company's functions were grouped into the responsibilities of seven divisions. The Mining and Metallurgical Divisions are responsible for all operational functions related to production. The service divisions are Geology, Controllers, Employe & Public Relations, Industrial Engineering, and Plant Services.

The functions for which the Plant Services Division is responsible include:

1. Maintenance, alteration and major overhaul of all equipment, structures and grounds.
2. Construction and installation of all new facilities.
3. All engineering and design except industrial engineering and mining engineering.
4. Operation and distribution of all utilities.
5. All transportation and materials handling with combustion engine equipment.
6. All purchasing and stores.

Associated with these primary responsibilities are such activities as inspection, lubrication, dust and fume control, fire protection, salvage or disposal of obsolete and surplus, mail delivery, gardening, etc.

Fig. 1. The Plant Services Division at The Bunker Hill Co. is organized to make the best use of the capabilities of the individuals in the division. In other words, the chart is made to fit the man rather than trying to fit a man to the chart



Also the division has specified responsibilities in the insurance and tax program, the apprenticeship and training program, for safety, and for property and personnel accounting.

With the reorganization, all functions and activities for which Plant Services is responsible were listed and grouped for cost control purposes and for the purpose of assigning responsibility to the individual best qualified and best equipped to do the task.

From this information, the organizational structure was developed, the procedure manuals composed, and policies established.

Organization Chart Not Sacrosanct

Figure 1 shows the Plant Services organization as it is today. The basic organization structure looks very much like the original but changes in responsibilities have been made to fit the particular capabilities of individuals as there have been changes in personnel. In other words, there is nothing sacrosanct about the organization chart—the company wants to be sure that all bases are covered and covered by the most capable men. The idea is to fit the chart to the man and not the man to a chart. Also, as processes are changed, plants added, and new techniques developed, work load changes require some realignment of responsibility.

The organizational structure is a combination of both functional and geographic. Most of the maintenance organization is paralleled functionally at each of the three plants.

Certain functions are performed company-wide by a single group of people assigned to the function. They are: engineering, instrumentation and combustion, fire prevention, painting, transportation, purchasing and stock control, plant services planning and control, and electric motor winding.

All other functions are performed by specific groups of people at each of the plants with a considerable interchange of work where there is need for specialized machines or talent. To cope with critical work load peaks, anyone may be used at any plant but generally it is felt that men like to work with their own group and for their own supervisor as much as practical. Thus, it is believed higher efficiency is obtained from workers familiar with a plant's peculiarities and history. For these reasons maintenance is largely done by people working exclusively in each plant.

The Plant Services Division normally employs 400 to 420 hourly workers. This may be increased by 50 percent during periods of accelerated new construction. There are 28 first-line supervisors in the division and the average is 15 hourly workers per first-line supervisor. Plant Services employes represent about 22 percent of the total for the Kellogg Operations.

Cost Control Program Has Four Primary Objectives

With the assignment of responsibilities and organizational structure accomplished, the next big job was the development of cost control systems. This was a very complex task since a system that would have the capability for providing all the essential cost information to all cost centers in all divisions, and with identified responsibility was wanted. To accomplish this required many discussions and conferences with other divisional personnel and, in some cases, considerable compromise.

Plant Services line and staff supervision controls are built around the concept of responsibility for four elements of cost control. These are called the 4M's—men, materials, methods, and money.

Basically, all Plant Services controllable costs are directly involved with either men or materials.

Methods and techniques are the tools for cost control.

Money is the final measure of control effectiveness.

This very concisely is the concept around which Plant Services cost control has been developed.

The cost control program has been developed for the purpose of accomplishing certain primary objectives:

1. Provide accurate distribution of costs to all organizational units and products.
2. Provide control essential to payment and collection of all contractual obligations, wages, purchases and sales.
3. Accumulate data to fix cost responsibility, to measure performance, to indicate high cost areas, and to determine success or failure in endeavors for improvement.
4. Accurately measure the contributions to reduced unit cost of product.

The system has been designed with the objective of keeping the paper work of the first-line supervisor to the bare essentials of providing, as simply as possible, the basic cost information, and returning to him only that cost data and information necessary to the control and administration of his unit.

Also, the system is designed for great expansion and maximum flexibility in accumulation and reporting techniques.

Work Orders Coded for Tabulating Purposes

The work order is the source of nearly all Plant Services control information. All workers time, transportation equipment time, and all materials used by Plant Services are charged to work orders. Only the Plant Services Division uses work orders which are of two types:

1. Standing work orders for all repetitive types of work.
2. Direct work orders for all other maintenance, construction and service work.

The work order form serves a threefold purpose.

1. A means of identifying all accounting details.
2. Authorization to do a job.
3. Specific information on what is thought to be the requirements and what was actually done, both in regard to men, materials and time.

The work order is made up in a four-part form: the original to the people who perform the job, one copy to the department charged for the work, one copy to I.B.M., and one copy held by the dispatcher. Upon completion of a job, the original coming from the field goes to the dispatcher who in turn, sends his copy to the department being charged for the work so they know the job is completed. The original is sent on to Planning & Control for analysis and future reference. If more than one crew is involved with the job, additional copies are made of the original.

The coded information at the bottom of the work order is a very important part of the control system. From this coding, a great variety of cost accumulations and reporting may be done by machine to provide data and reports that are a significant aid in telling where the company's money is going and where its efforts can be most effective.

With the sub-number grouping the I.B.M. reports tell what it costs for maintenance that is influenced by changing levels of production, what it costs for maintenance of structures, yards, and service facilities, what utilities cost, what it costs for time not worked because of grievances, safety work, travel time, etc., and the costs of special services which are not a part of maintenance nor influenced by production levels.

Every major piece of equipment or structure carries an identifying number to which the facilities costs are tied. All small items are grouped into

The Plant Services work order is a four part IBM card form. All instructions and accounting information is on the front. The back is used for information relative to analysis and future improvements

DATE | TIME | A.M. P.M. | PLANT SERVICES WORK ORDER A 2043

REQUESTED BY | EQUIPMENT AVAILABLE DATE | TIME A.M. P.M.

COMPLETION DATE REQUIRED | DATE STARTED | DATE FINISHED

DESCRIPTION OF WORK TO BE PERFORMED

FRONT

DEPT. CHARGED | W/E NO. | EQUIP. NO. | ACTIVITY | PROD.

CRAFTS REQUIRED

BOILER MAKER
CARPENTER
ELECTRICIAN
INSTRUMENT
MACHINIST
MASON
MECHANIC
PAINTER
PIPE FITTER
RIGGER
WELDER
Ph. WELDER

EQUIP. CHARGE HAS BEEN MADE ☐

IF SO FILL OUT INVENTORY ALERT FORM

EXACT NATURE OF TROUBLE

WHAT CAUSED FAILURE

CORRECTION YOU MADE

BACK

WHAT IMPROVEMENTS DO YOU RECOMMEND

Signature

EACH YEAR THE THREE BEST SUGGESTIONS WILL BE AWARDED PRIZES OF:
$100.00 $50.00 $25.00

numbered categories.

With the coding system used, it is possible to get many special reports by machine sorting and tabulation at infrequent intervals and not have volumes of paper flowing across desks that are only of infrequent value.

The work order may originate with anyone, but all are made out by the dispatcher from information phoned to him or given orally. This was not done at first, but too many mistakes in coding resulted from everyone writing work orders.

Three Sources Provide Bulk of Cost Control Information

All materials and supplies requisitioned from stores by Plant Services are charged to a work order number.

Employe payroll data is supplied from the field by time clock punch cards, showing time charged to work order numbers.

These three field information sources, the work order, stores requisitions and time card provide a very high percentage of all the cost information needed for cost control of the Plant Services Division.

I.B.M. receives this data daily and processes it to provide the cost reports considered essential to good control.

Man-hour reports are sent daily to the department being charged and to the department making the charge. This report lists the name of the individual charging his time to the department, the number of regular hours and overtime hours. This is one of our most effective controls. Dispatchers are continually being asked by operations questions like this: "How come I was charged eight hours for an instrument man and I never saw one all day?" or, "I am not going to pay for 16 hours of a mechanic's time when those four men spent two hours doing nothing in my department yesterday." Finding the answers points out the ways to better manpower utilization and is a healthy way to keep labor and supervision on its toes.

Materials and supplies costs are reported weekly to the department charged and to the department requisitioning the supplies. Monthly I.B.M. reports show each department what each of the Plant Services units has cost them for the past month's work. The repair materials and manpower costs are also reported by equipment number and service sub-number. These reports show the hours and cost of premium pay, the cost of each utility and the man-power costs broken down to show direct costs and burden.

Each Plant Services functional unit carries its own specific burden. The burden is made up of costs of the units pro-rata share of overhead,

The work order file is a good graphic indicator of volume of maintenance work done on individual pieces of equipment

taxes, insurance, depreciation, utilities, fringe benefits, maintenance of the unit, and direct costs of time not worked. The total burden for the unit is divided by man-hours worked by the unit to determine the hourly burden rate.

The hourly burden rate plus the individuals hourly direct wage is the charge per man-hour worked for all Plant Services hourly employes.

Today, Plant Services average charge per man-hour worked is $4.38. The average direct wage of the Plant Services hourly worker is $2.50 per hour. The average wage of the operations hourly worker is $2.33.

The high hourly charge has created some problems. Some feel that fixed indirect costs should be accounted for in some other manner that is better understood by lower levels of supervision and keep the individual supervisor's attention focused on the controllable cost elements for which he is truly responsible.

Planning and Control Unit is Record Center

The Planning & Control unit of the Plant Services Division has as its primary objective, "keeping accurate records of what we have done and keeping us advised of where we can most effectively work to further reduce final costs of the unit product."

The Planning & Control unit keeps all historical data by equipment number. All work orders for equipment are filed behind the individual equipment card and the varying thickness of the individual file is a perfect graph of the activity on each piece of equipment. The most frequent activity, however, is not always the most expensive. I.B.M. runs a monthly summary of materials and man-hours costs by equipment number. A copy of this report goes to Planning & Control to complete their record of costs for each major piece of equipment. The equipment file is so arranged that all scheduling of maintenance, preventative maintenance and inspection is done by this group. Many work orders a month originate here. The scheduling service is utilized by all Plant Services people to remind them to do a task some time in the future. The Planning & Control files contain a copy of all instruction manuals, repair parts lists, original orders, specifications and costs for each piece of equipment. Frequently this source of information proves invaluable to the men in the field. Keeping the information up to date is largely one of reminding field men of the convenience when they want the information.

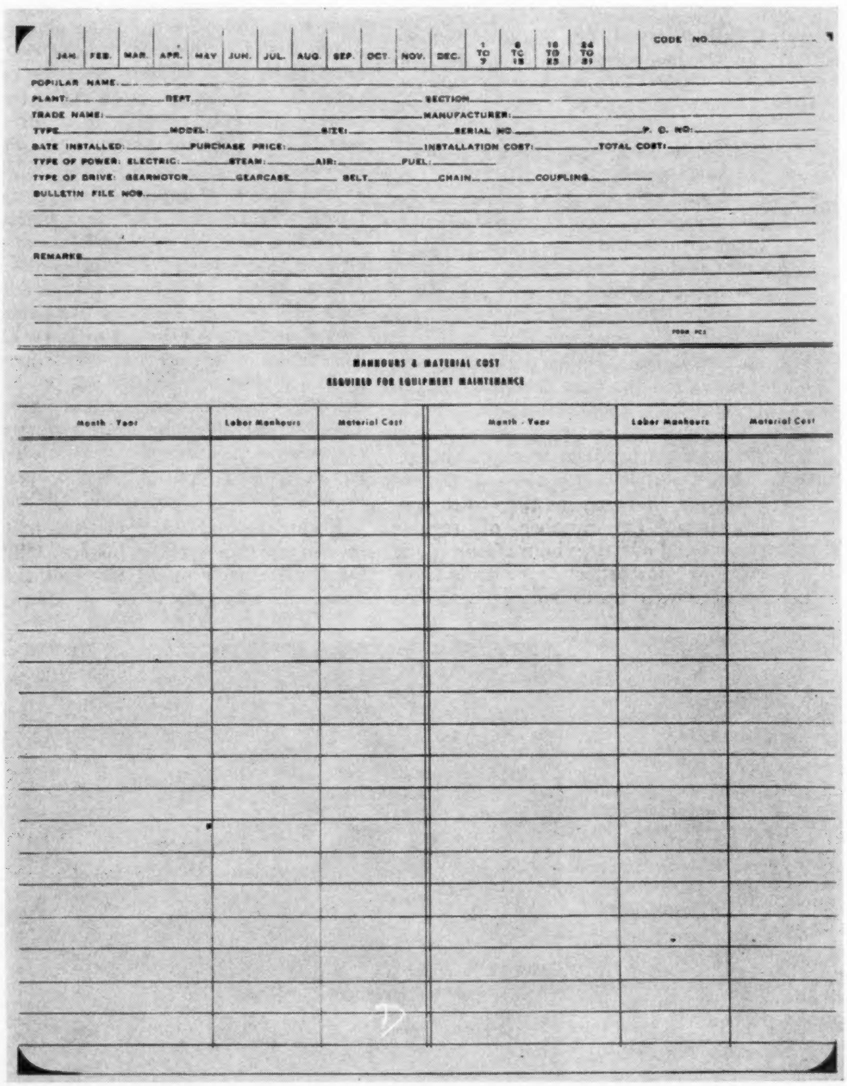
Planning & Control is the central office for all Plant Services direction for they can tell the division what it has tried, where it has succeeded, and where it has failed; and point out the most fertile areas for future improvement.

Effort Needed to Reduce Costs

Two budgets are prepared just before the end of the year for controlling the following year's expenditures.

The division's operating budget is compiled for each unit, department, and for the division with the

(continued on page 47)



JAN. FEB. MAR. APR. MAY JUN. JUL. AUG. SEP. OCT. NOV. DEC. 1 TO 7 | 8 TO 15 | 16 TO 23 | 24 TO 31 CODE NO.

POPULAR NAME:
PLANT: DEPT. SECTION
TRADE NAME: MANUFACTURER:
TYPE MODEL: SIZE: SERIAL NO. P. O. NO:
DATE INSTALLED: PURCHASE PRICE: INSTALLATION COST: TOTAL COST:
TYPE OF POWER: ELECTRIC: STEAM: AIR: FUEL:
TYPE OF DRIVE: GEARMOTOR GEARCASE BELT CHAIN COUPLING
BULLETIN FILE NOS.
REMARKS

MANHOURS & MATERIAL COST
REQUIRED FOR EQUIPMENT MAINTENANCE

Month - Year	Labor Manhours	Material Cost	Month - Year	Labor Manhours	Material Cost

This form is typical of those used by planning and control for historical data and for preventative maintenance scheduling

Some 60 coal industry officials met in Pittsburgh on November 16 to prepare the program for the 1962 Coal Convention scheduled for next May 6–9 in this coal and steel center

Program Committee Meets to Plan

1962 COAL CONVENTION

Leaders from the coal mining industry, Government, and education groups will lend their talents to the excellent program being planned for the 1962 Coal Convention of the American Mining Congress next May 6–9 in Pittsburgh, Pa.

At a meeting in Pittsburgh November 16, the Program Committee for the Convention distilled the hundreds of suggestions for convention papers that had been received from all corners of the Nation into a concentrated three-day program which will bring the industry abreast of the latest developments in coal mining and preparation technology. Keeping in mind today's trend to higher capital investment for new coal mines, the Committee, headed by L. H. Chalfant, manager, Bethlehem Mines Corp., designed the program with a special view to stimulate the search for new approaches to solutions of the old question of how to reduce mining costs.

Following an opening session on Monday, May 7, which will be devoted to addresses of broad general interest to coal mining men, ten technical sessions will be used to paint the picture of progress in mining technology. In addition to sessions on strip mining, mechanical mining, safety, coal preparation, maintenance, and management techniques, a special session will be devoted to hydraulic mining, hoisting and transportation of coal.

The lighter side of the Coal Convention will not be neglected either. Plans are being made for a full schedule of entertainment, including the annual Coal Miner's Party and a special Banquet. An attractive program of events for mining ladies is also being arranged. On Thursday, May 10, several special trips of interest to mining men will be scheduled. More on these later.

The cost-cutting ideas of tomorrow will be unveiled and their potential evaluated at the 1962 AMC Coal Convention. No progressive mining man will want to miss it—make plans now to attend!

PRELIMINARY PROGRAM

Monday May 7
Morning—Opening Session

Tuesday May 8
Morning—Strip Mining, with emphasis on smaller equipment
—Safety, an engineering approach

Wednesday May 9
Morning—Hydraulic Mining, Hoisting and Transportation of Coal
—Maintenance of Mining Equipment

Afternoon—Strip Mining, with emphasis on large equipment
—Mechanical Mining

Afternoon—Coal Preparation, the trend in modern flowsheets
—Mechanical Mining

Afternoon—Management Tools and Techniques
—Coal Preparation, with emphasis on fine coal

Fine Coal Cleaning with Heavy Medium Cyclones

New cyclones have proven they are able to wash fine coal regularly and efficiently at a specific gravity of 1.46. On one occasion a separation at 1.31 specific gravity gave a recovery of 85 percent

By WILLIAM BENZON
Superintendent of Preparation
Bethlehem Mines Corp.

EARLY in 1959 the Bethlehem Mines Corp. chose to make the first installation in the United States of the Dutch State Mines heavy medium cyclones for cleaning fine coal.

The cyclones were installed at the Century mine, which is located near Buckhannon, W. Va., in the Redstone seam.

Raw coal feed to the plant is 150 tph, crushed to five-in. round top size. The large sizes, 5 by 1¼ in. and 1¼ by ⅜ in., are washed in hydroseparators. The fine coal, ⅜ in. by 0, was cleaned on an air jig. The air jig would not operate with wet coal feed and it was decided to replace the jig with a washing plant of some type. Tables, fine coal washing jigs and Hydrotators were considered. Any one of the three would have produced a satisfactory ash from the raw fine coal produced at that time. However, there were areas in the mine in which the seam included a thick top bench of middle gravity bone. This bone comes with the coal and results in a raw coal that is difficult to clean. It was desirable, therefore, to be able to wash to a specific gravity as low as 1.35. When a commercially proven heavy medium cyclone washing system became available in the United States, pilot plant tests were made on the Century coal. These tests proved satisfactory and a plant was purchased.

Plant Cleans 150 tph of Raw Coal

The Century plant, including coarse and fine coal washing, requires one operator per shift. The heavy medium cyclone circuit includes three pumps, four screens, a centrifuge, a magnetic separator, an air compressor and two small conveyors. A circuit to clean the 28-mesh by 0 coal includes three pumps and one screen. The power requirement for the ⅜-in. by 0 cleaning and dewatering is 3.8 hp per ton of feed.

Raw coal, at the rate of 150 tph, is crushed to a top size of five-in. round and is elevated by flight conveyor to the top of the washer building. It is discharged onto a 6 by 18-ft double deck screen, where 1250 gpm of water are used to separate the fines. The top sizes, 5 by 1¼-in. and 1¼ by ⅜ in., report to hydroseparators.

The ⅜-in. by 0 coal, 75 tph, is sluiced to a 6 by 12-ft vibrating, desliming screen for the removal of 28-mesh by 0 material. The feed to the screen passes first over 15 sq ft of curved stationary screens (Sieve Bends). The Sieve Bends are constructed of wedge wires runing across the feed flow and spaced one mm apart. A large part of the 28 mesh by 0 is removed before the feed reaches the vibrating screen, which is provided with a wedge-wire type deck with ½-mm (28 mesh) openings. One bank of fresh water sprays is used on the vibrator for additional desliming. The deslimed feed at the rate of 60 tph (dry basis) leaves the screen carrying two to four percent undersize and approximately 20 percent water.

The ⅜ in. by 28-mesh raw coal falls through a chute into the heavy medium pulping tank. The raw coal is directed to the pump suction by a vertical feed tube, located in the center of the tank and extending almost to the tank bottom. Without this feed tube much of the raw coal would float on the surface, and the tank would fill with coal.

A six-in. horizontal pump draws the pulp from the tank at a rate of 1400 gpm. The ratio of coal to medium is about one part to six parts by weight. The pump discharge line is extra heavy steel pipe leading to a symmetrical "Y" fitting where the stream is split into two lines, each feeding one washing cyclone.

The washing cyclones are constructed of six Ni-Hard castings about ¾ in. thick. The over-all length is 62 in. The inside diameter is 20 in., the vortex diameter 8½ in., the underflow opening seven in. and the included angle of the conical section is 20°. The cyclones are placed in a near horizontal position, tilted enough to be self-draining. The cyclones each have a rated capacity of 55 tph of raw coal. In this plant the total feed is 60 tph, or 30 tph to each cyclone.

The products from the cyclones flow to rinsing screens. There are two clean coal rinsing screens, each 5 by 16 ft, provided with a wedge-wire deck with ½-mm openings, total screen area 160 sq ft. Ahead of each screen are Sieve Bends, one mm openings, with a total area of 20 sq ft for the two units. One 3 by 16-ft vibrating screen, preceded by 5 sq ft of Sieve Bend, receives the refuse from both cyclones for rinsing. The clean coal rinsing screens have three banks of clarified water sprays and one bank of fresh water sprays. The refuse screen has two banks of clarified water sprays and one bank of fresh water sprays. The quantity of rinse water used for clean coal is 170 gpm of clarified water and 40 gpm of fresh water for each screen. On the refuse screen the quantities are 90 gpm of clarified water and 30 gpm of fresh water. The major portion of the medium is recovered, undiluted, from the cyclone products through the Sieve Bends and the first three ft of the vibrating screens. This medium returns to the pulping tank by way of a head box. The lesser portion of the medium, recovered by rinsing, flows to the dilute medium sump. The clean coal at 25–30 percent moisture, is discharged from the screens over a three in. high dam, and is conveyed to a centrifuge. The refuse is discharged over a dam and is conveyed to the refuse bin.

The equipment used to reclaim the magnetite from the rinse water consists of a sump with pump, one classifying cyclone, a magnetic separator and a settling cone.

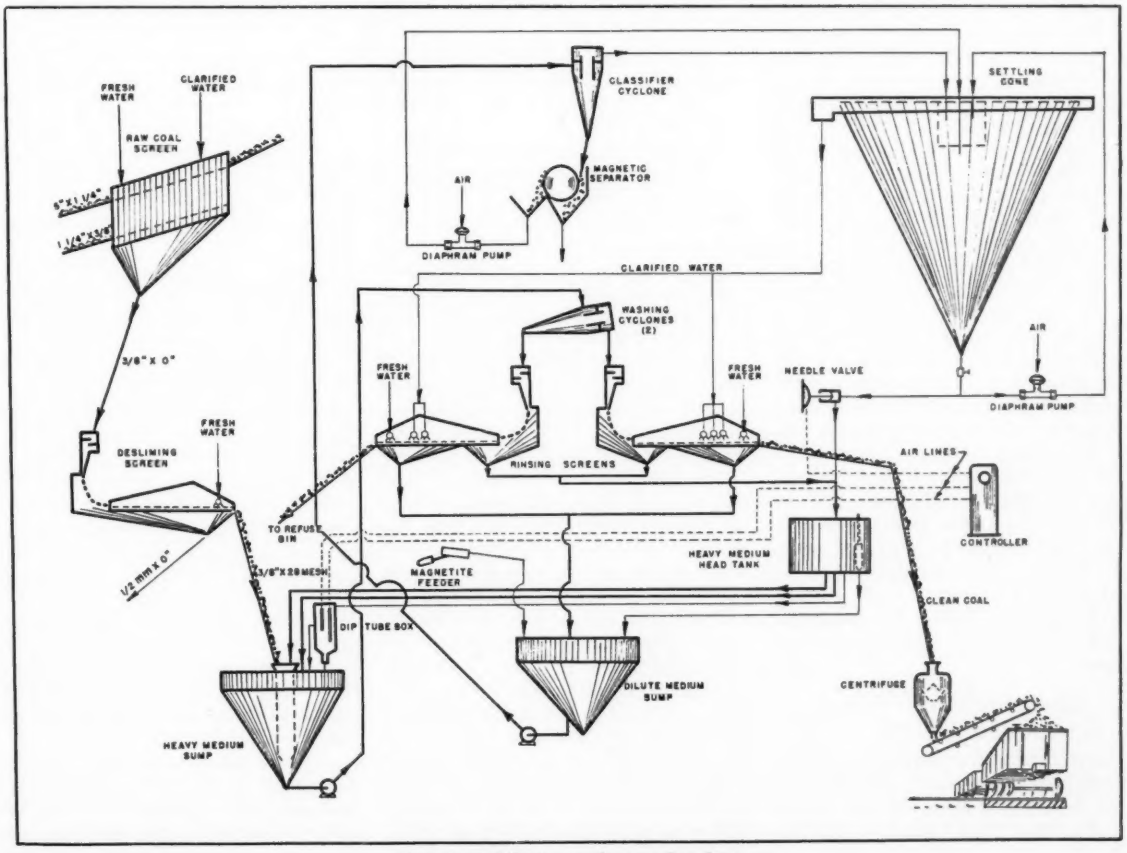
The dilute medium sump is a conical tank located beneath the rinsing screens. In addition to the medium rinsed from the products this tank receives circulating medium from the head box at times when the pulping tank tends to overflow. As needed, fresh magnetite is fed into the dilute medium sump from a hopper holding 700 lb of magnetite.

A six-in. horizontal pump draws the dilute medium from the sump at a rate of 700–800 gpm, delivering it to one classifying cyclone. The dilute medium contains from 50 to 200 gms per gal of coal and from 125 to 500 gms per gal of magnetite.

The function of the classifying cyclone, which is identical to the washing cyclones, is to remove from the medium the undersize coal and refuse (minus ½ mm) resulting from imperfect desliming of the feed and from degradation. The classifier underflow, containing 200–500 gms per gal of fine coal and 600–3000 gms per gal of magnetite, flows at the rate of 55 gpm to the magnetic separator. Since this underflow, containing 30–40 percent solids, is too dense for the separator, it is diluted with 90–100 gpm of fresh water.

The separator is an electromagnetic drum type, 30 in. in diam and two ft wide. The recovered magnetite is returned to the settling cone by an air operated diaphram pump. Tailings from the separator are removed from the system at the rate of about 150 gpm and contain from 50 to 300 gms per gal of nonmagnetics (coal and refuse) and from 0.9 to 5.4 gms per gal of magnetite.

Overflow from the classifying cyclone is discharged to the settling cone. It has two functions. The first is to supply densified medium to the pulping tank, making up for the magnetite removed in the rinsing operation. The second is to supply clari-



Flow sheet of Century cyclone washer plant

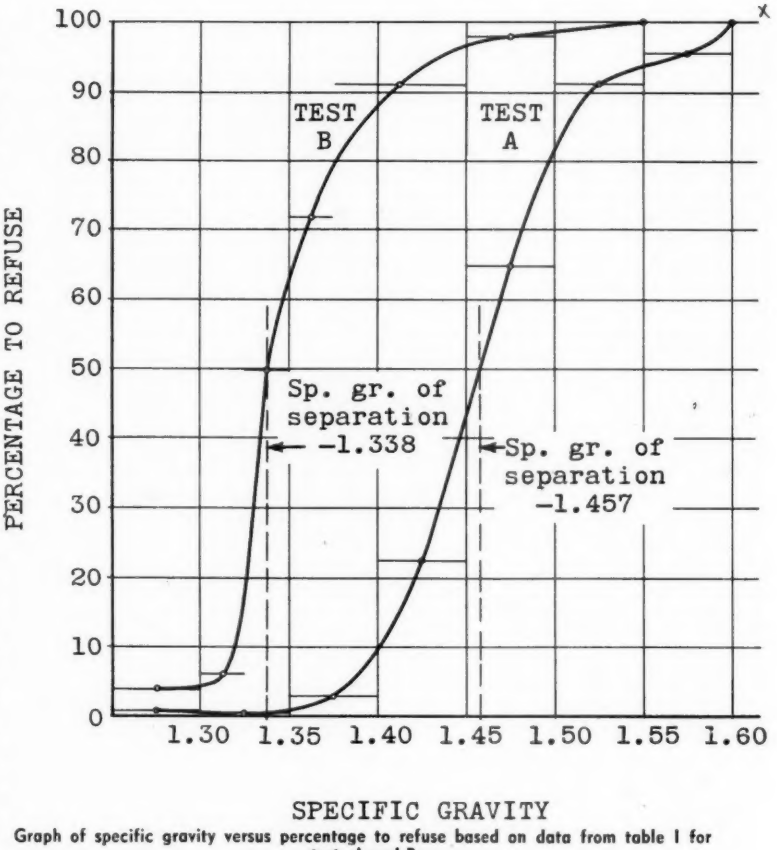
fied water for the primary sprays on the rinsing screens. Densified medium from the cone varies from 1.60 to 2.00 sp gr. The higher density is the more desirable, although a 1.40 washing density can be maintained with the 1.60 sp gr make-up. The lower density is the result of fine coal reporting to the classifier overflow instead of to the underflow and thence to the separator. At this time work is in progress to reduce the quantity of fine coal reporting to the cone. The overflow from the settling cone, clarified water for primary rinsing, contains about 0.2 gms per gal of magnetite and from 20 to 70 gms per gal of nonmagnetics, the latter being smaller than 60 mesh in size.

Gravity Held in Narrow Range

The specific gravity of the medium is kept at the desired value by a Foxboro pneumatic recording controller which receives a signal from a pair of dip tubes. Undiluted medium from the product Sieve Bends and densified medium from the settling cone collect in a head box and flow from the head box in three streams. Two of the streams carry the bulk of the medium directly to the pulping tank, one to a point within the feed tube and the balance to a point between the tube and the tank wall. A two-in. line carries a stream of medium to the dip tube box, keeping the tubes immersed in a constant level of medium. The dip tubes are of different lengths. Air from the controller is passed through the tubes at a rate of five cu ft per hour. Back pressure from the short dip tube is lower than back pressure from the long tube. This difference in pressure is directly proportional to the density of the medium and is used by the controller to actuate the needle valve under the settling cone, admitting densified medium to the head box as required. Experience has shown that the washing medium can be controlled within the limits of ± 0.003 specific gravity units. That is, if it is wished to maintain a 1.40 specific gravity, the line on the control chart can be kept in the range of 1.397 to 1.403. The density of the medium in the system can be raised or lowered quickly; for example, from 1.40 to 1.55 (or reverse) in five minutes.

Commercial Results Better Than Pilot Tests

Normal washing gravity in the cyclones at Century is 1.46. Separations have been made at as low as 1.31 sp gr. Results of two tests are given in table I.



Graph of specific gravity versus percentage to refuse based on data from table I for tests A and B

In test A, the medium gravity was set at 1.40, resulting in a separation of coal from refuse at 1.46 sp gr. At this point the near gravity is only 9.0 percent, so the separation is not a difficult one. The total misplaced material amounts to 1.7 percent of the feed, and the recovery efficiency is 99.1 percent.

In test B, the medium gravity was set at 1.28, resulting in a separation at 1.34 sp gr. At this point the near gravity material is 90 percent of the feed (adjusted for rock content), so the separation is a very difficult one, yet the total misplaced material was only 8.0 percent of the feed, and the recovery efficiency is 96.0 percent.

As shown in the table the product ash is very close to the theoretical value at the recovery made. Day-to-day results are uniform, varying only with the inherent ash of the raw coal.

As an example, during a five week period when the plant was operated to make a separation at 1.46 sp gr, the average ash content of the cleaned coal was 5.5 percent, with a range of from 4.9 to 6.2 percent. During this same period 17 performance tests were made on the plant. The 1.45 sp gr float ash in the feed coal for these tests averaged 5.3 percent, ranging from 4.3 to 6.5 percent. The range in product ash closely parallels the range in float ash.

The air jig, replaced by the cyclones, had been producing a cleaned coal with about nine to ten percent ash.

In most of the tests, the analyses were made on the full size range, 3/8 in. by 28 mesh. Pilot plant tests, made before the Century plant was built, indicated that sizes within the range were washed at almost the same specific gravity. This has not yet been checked at Century, though there is one test in which ash analyses were made on different sizes. The results are shown in table II.

The test shows a decrease in ash down to 60 mesh followed by a small increase down to 200 mesh. Perhaps the ash figures below 60 mesh cannot be taken too seriously since it is possible that degradation in processing the sample has a factor in producing the fines. It will be noted that the deslimed feed contained only 2.2 percent undersize (28 mesh by 0). The commercial plant results are

TABLE I

Test A—Specific Gravity of Medium = 1.40

Specific Gravity	Feed % Weight	Feed % Ash	Clean Coal % Weight	Refuse % Weight
1.30	49.06	3.1	54.4	4.2
1.30–1.35	32.77	6.0	36.4	1.6
1.35–1.40	6.65	10.9	7.2	1.7
1.40–1.45	1.65	16.1	1.4	3.5
1.45–1.50	1.25	20.8	0.5	7.7
1.50–1.55	0.69	24.4	0.07	6.0
1.55–1.60	0.68	28.2	0.03	6.2
1.60 sink	7.25	58.4	0	69.1

Sp. gr. of separation	1.46	Theoretical yield at 5.0% ash	90.4%
Near gravity mat'l., ± 0.1	9.0%	Difference in yield	0.8%
Probable error	0.030	Recovery efficiency	99.1%
Yield of clean coal	89.6%	Theoretical ash at yield	4.9%
Ash content of clean coal	5.0%	Ash difference	0.1%

Misplaced material at 1.46 sp. gr.—
in clean coal – 0.50% of c.c. or 0.45% of feed @ 22.0% ash
in refuse – 12.00% of ref. or 1.25% of feed @ 11.0% ash
total 1.70% of feed

Test B—Specific Gravity of Medium = 1.28

Specific Gravity	Feed % Weight	Feed % Ash	Clean Coal % Weight	Refuse % Weight
1.30	56.47	3.5	69.8	10.0
1.300–1.325	20.46	6.8	24.6	6.1
1.325–1.350	6.31	9.4	4.1	14.0
1.350–1.375	2.61	12.3	1.0	8.3
1.375–1.45	3.79	16.0	0.5	15.5
1.45 –1.50	0.96	21.2	0	4.2
1.50 –1.55	0.96	23.3	0	4.3
1.55 –1.60	0.65	29.9	0	2.9
1.60 sink	7.79	67.8	0	34.7

Sp. gr. of separation	1.34	Theoretical yield at 4.6% ash	80.8%
Near gravity mat'l., ± 0.10	9.0%	Difference in yield	3.2%
Probable error	0.019	Recovery efficiency	96.0%
Yield of clean coal	77.6%	Theoretical ash at yield	4.4%
Ash content of clean coal	4.6%	Ash difference	0.2%

Misplaced material at 1.34 sp. gr.—
in clean coal – 2.8% of c.c. or 2.17% of feed @ 12.0% ash
in refuse – 26.0% of ref. or 5.83% of feed @ 6.0% ash
total 8.00% of feed

In test A, the medium gravity was set at 1.40, resulting in a separation of coal from refuse at 1.46 sp gr. At this point the near gravity material is only 9.0 percent of the feed, so the separation is not a difficult one. The total misplaced material amounts to 1.7 percent of the feed, and the recovery efficiency is 99.1 percent

In test B, the medium gravity was set at 1.28, resulting in a separation at 1.34 sp gr. At this point the near gravity material is 90 percent of the feed (adjusted for rock content), so the separation is a difficult one, yet the total misplaced material is only 8.0 percent of the feed, and the recovery efficiency is 96.0 percent

somewhat better than the pilot plant tests.

Routine Separations May Be Made at 1.35 Specific Gravity

The plant was put into operation in December 1959. Originally the rinsing screens and desliming screens were dressed with wire cloth. No protection had been provided for the cloth against the impact of the sprays, and the wire decks on the rinsing screens were cut through under the sprays after six shifts of operation. Steel pans, 8 in. wide by 1 in. deep were placed under the spray headers, protecting the screens and acting as washing pockets, giving better removal of magnetite.

There has never been any difficulty in making separations at 1.50 sp gr or higher. However, at the start it was difficult to make a separation at 1.35 sp gr.

In the original plan the concentrates from the magnetic separator flowed to the pulping tank via the head box. These concentrates, originating in the classifier underflow, were the coarser particles of magnetite. The result was that washing was attempted with relatively coarse magnetite and the medium was not stable at low specific gravities. Action within the washing cyclones stopped and the entire feed reported to the refuse screen. This was corrected by installing a pump to return the concentrates to the settling cone, providing a make-up medium of uniform size composition.

It was also found necessary to change the apex opening of the washing cyclones. A six-in. opening permitted efficient high gravity separations, but again it was not possible to go below 1.50 sp gr. This was increased to seven in. and separations at 1.35 sp gr with recovery efficiencies of 96 percent and higher were obtained. On one occasion a separation was made at 1.31 sp gr with a recovery efficiency of 85 percent.

As could be expected, washing results are affected by wear of the apex, recovery efficiencies decreasing slightly, more noticeably at lower operating gravities. The useful life has not yet been determined. After 1600 operating hours, processing 42,800 tons of raw coal, the Ni-Hard apex showed an increase in diameter of ½ in. from 7 to 7½ in. Recovery efficiency at the 1.45 sp gr level decreased less than 0.5 percent, and at the 1.35 sp gr level about 1 to 1.5 percent. The wear can be followed by checking the specific gravity of the medium reporting with the coal. With an apex diameter of 7.0 in., and input medium of 1.40 sp gr, the medium overflowing with the clean coal has a specific gravity of 1.32. When the apex is worn to 7.5 in. an input medium of 1.40 sp gr results in a medium overflow at 1.23 sp gr. The

TABLE II

Size	Feed Wt. %	Feed Ash %	Clean Coal Wt. %	Clean Coal Ash %	Refuse Wt. %	Refuse Ash %
+ 14 mesh	77.2	8.7	79.0	5.1	75.64	45.9
14 × 28 mesh	20.6	10.6	19.9	5.0	23.51	39.4
28 × 60 mesh	1.5	12.1	0.8	4.7	0.38	37.6
60 × 100 mesh	0.2	11.8	0.1	5.5	0.05	36.8
100 × 200 mesh	0.2	12.4	0.1	6.6	0.07	32.6
200 × 0	0.3	22.5	0.1	16.4	0.35	51.6
Total		9.19		5.1		44.3

Ash analysis made on a range of cyclone feed sizes

DISCUSSION:

By C. KRIJGSMAN
Head
Coal Preparation Division
The Dutch State Mines

THE magnetite loss of 2.12 lb per ton of feed reported by Mr. Benzon is too high for this product. Losses of one to 1½ lb per ton of feed are found in cyclone washeries in France, Belgium and the Netherlands.

Data from the Century plant indicate that the main losses were in the tailings from the magnetic separator and perhaps this magnetic separator was not doing a proper job, since there were variations in efficiency of recovery of this separator from 99.3 percent to 99.8 percent. With the magnetite feed varying between 150 lb and 275 lb per min, the efficiency of recovery could be maintained at 99.8 percent, in which case a notable drop of the magnetite losses should be found.

With regard to the wear of the cyclone washers, in Dutch State Mines it has been found, as in the Century plant, that a cyclone constructed without flange joints lasts four times as long.

Quite recently a new type rinser has been developed which makes it possible to use much less rinsing water, resulting in a lower power consumption and a simple regeneration system. This new rinser is now being tested.

With regard to the size of coal treated in the cyclone washeries—of the 55 Dutch State Mine cyclone washer installations for coal now in operation, or under construction, all over the world most are handling coals below ½ in. in size. However, good results have been obtained with some cyclone plants washing coal up to about 1½ in. in size. For example, a 92-tph cyclone washery plant in Rhodesia is handling 1¼ in. by 35-mesh coal in two 20-in. cyclones with accurate results. Thus, very simple washeries can be obtained.

Dutch State Mines' figures show a cut point for the 35 mesh by ½-in. product at 1.48, and for the plus ½-in. product at 1.49, the probable error being 0.017 and 0.011 respectively.

The cyclone washer "water only" type for the minus 28 mesh material is important. This type of cyclone is different from the well known cyclone classifier. As compared with froth flotation, it is a simple tool. The obtained ash of the clean coal can be altered, if desired, by making some simple changes in the hydrocyclone.

washing gravity increases about 0.02 with this wear.

There is a tendency for the rinsing screens to become blinded by fine particles, particularly when feed to the plant is stopped. The openings must then be cleared by the operator, who uses a wire brush on a long handle to scrub the screen decks. An experiment is in progress to prevent this blinding by bypassing the washing cyclones and rinsing screens when there is no feed.

The settling cone has not given trouble-free operation. As described before, concentrates from the magnetic separator and the overflow from the classifying cyclone constitute the feed to the cone. The classifier overflow contains some fine coal particles which have a lower settling rate than the magnetite. The main flow currents within the cone are from the center upwards and toward the cone circumference. The coal particles tend to settle on the sides of the cone above the magnetite and do not flow uniformly to the apex.

This is a minor nuisance that it is hoped will be eliminated by varying the operating conditions of the classifying cyclone to reduce the quantity of fine coal being delivered to the cone. No doubt a Dorr type thickener in place of the settling cone would be a satisfactory solution. Two plants that are under construction will have thickeners.

Data on Equipment Life Incomplete

During 15 months of operation the heavy medium plant operated 4456 hours (including many idling periods), washing 208,000 tons of raw coal.

Only partial data on equipment life has been developed.

The washing cyclones had each processed 104,000 tons of feed. The estimated life of these units is 124,000 tons, which will bring the cyclone cost to 1.1 cents per ton. These first cyclones were made of several castings and tend to wear quickly at the flanged joints. The replacements will not have these wear points, will be thicker where maximum wear occurs, and are expected to give four times the life of the segmented cyclones.

The classifying cyclone shows very little wear.

The dilute medium pump has required no replacements to date.

The heavy medium pump has required two replacement impellers, four casing rings, one neck ring, and one shaft sleeve. These items cost 7.6 mils per ton of coal.

The screens, one desliming, two clean coal rinsing, and the refuse rinsing screen, were originally dressed with wire cloth. Total cost of wire cloth for the four screens amounted to 3.8 cents per ton of raw coal. All but the refuse screen have been changed to Wedge Wire decks. The first one to be changed, a coal rinsing screen, has been in service about one year, handling over 62,000 tons of coal and showing very little wear. We expect an appreciable saving in cost with Wedge Wire decks.

The Sieve Bends feeding the vibrating screens have given good life, 4000 hours on the desliming operation, and 220 hours on the rinsing operation. The cost amounts to 0.6 cents per ton of raw coal.

There have been no replacements in the piping, and no leaks to date.

Magnetite Consumption Improved

Grade "B" magnetite is used, approximately 90 percent passing 325 mesh.

Magnetite consumption for the first 16 months of operation, December 1959 through March 1961, was 3.25 lb per ton of clean coal (2.92 lb per ton feed). This includes losses in handling, when draining pumps, occasional overflows, and deliberate losses taken during periods of experimentation.

For the first three months of 1961 the consumption was 2.35 lb per ton of clean coal (2.12 lb per ton feed). The improvement was accomplished through study of the rinsing operation and study of the magnetite cleaning circuit, i.e., the classifying cyclone and magnetic separator.

Measurements of magnetite lost with the rinsed clean coal and refuse vary between 0.06 lb per ton and 1.2 lb per ton, with an average of 0.4 lb per ton of clean coal (0.36 lb per ton feed).

The magnetic separator must cope with loadings that vary considerably. The volume of feed to the separator is kept substantially constant at 140 to 150 gpm. However, the magnetite in the feed varies from 150 lb per min to 275 lb per min. Magnetite in the tailings, under these conditions, fluctuates from 0.9 gm per gal to 5.4

TABLE III

Size	Feed		Product		Refuse	
	Wt. %	*Ash %*	*Wt. %*	*Ash %*	*Wt. %*	*Ash %*
Test No. 1—Yield – 87.0%						
+ 30 mesh	19.0	16.8	9.5	4.9	56.3	39.0
30 × 48 mesh	27.0	11.8	22.2	4.6	29.0	45.2
48 × 100 mesh	27.0	6.4	30.2	4.0	11.1	59.2
100 × 200 mesh	27.0	5.5	38.1	4.4	3.6	61.5
Total	100.0	9.6	100.0	4.4	100.0	43.8
Test No. 2—Yield – 90.0%						
+ 30 mesh	16.5	15.2	16.9	5.4	54.1	34.5
30 × 48 mesh	19.6	11.7	21.5	6.0	25.9	42.4
48 × 100 mesh	24.8	8.1	25.8	6.1	14.9	53.3
100 × 200 mesh	39.1	6.1	35.8	5.6	5.1	38.9
Total	100.0	9.2	100.0	5.8	100.0	39.6

Ash determinations for the feed to the hydrocyclones and the product from the hydrocyclones

gm per gal, and the efficiency of recovery from 99.3 percent to 99.8 percent.

Hydrocyclones Used on Mines 28 Mesh

The heavy medium cyclones process the fine coal down to 28 mesh. The 28 mesh by 0 cannot be discarded, and it must be cleaned and recovered.

The circuit provided to accomplish this consists of a sump with pump to feed four hydrocyclones, and a sump with pump to feed two thickener cyclones.

The first feed sump receives the 28 mesh by 0 raw coal from the desliming screen and the tailings from the magnetic separator.

The hydrocyclones are 14 in. in diam by 28 in. high. The feed diameter is 2½ in., the vortex diam 6 in., the apex opening two in., and the included angle of the conical bottom is 75°. Feed rate to the cyclones is 1400 gpm, containing approximately 16–17 tph of plus 200 solids.

Underflow from the hydrocyclones, consisting of the refuse with very little water, reports to a 3 by 8 ft vibrating screen. The screen oversize plus 30 mesh goes to the refuse bin while the undersize is pumped to a slurry pond together with additional plant waste water. Overflow, containing the cleaned coal, flows to a tank from which it is pumped to the thickeners.

The two thickener cyclones are identical to the dilute medium classifier. Overflow, containing about six percent solids, supplies the major portion of the water used on the raw coal screen. Approximately 200 gpm are pumped to waste. The underflow, containing the cleaned coal from the hydrocyclones at a concentration of 45 to 55 percent solids, reports to the centrifuge to be dewatered with the ⅜ in. by 28 mesh coal.

Ash determinations have been made on the feed to hydrocyclones and the products from the hydrocyclones. Results of two tests are given in table III.

PLANT SERVICES PROGRAM AT BUNKER HILL

(continued from page 40)

supervisor responsible for the costs assisting in the determination of budgeted costs.

This control tool is an aid to top management for cost control and profit projection. But for real effective cost reduction, the day-to-day probing, questioning, analyzing, and correcting right at the job level is much more productive.

Plant Services is also responsible for the preparation and administration of the company's capital budget. However, each of the divisions is responsible for keeping its capital expenditures within the budget.

If construction is involved with the capital expenditure, Plant Services is responsible for the cost and construction program. Construction may be done by contract or with Bunker Hill employes. In general, if the construction is isolated from the company's production facilities, the job is contracted. If process facilities become involved and scheduling is tight, the job is contracted.

How is Performance Measured?

For Plant Services not any single index of performance has been found that alone had much value. It is not felt that other companies costs mean anything.

A number of indexes are used as gauges of success or failure. If all the indexes are favorable, we are making progress; if they are all bad, we are in real trouble. If some are favorable and some not, this is an indication of where we are slipping, but finding out why is not always easy.

Space limitations will not permit great detail of how the quality and efficiency of the division's activities are measured.

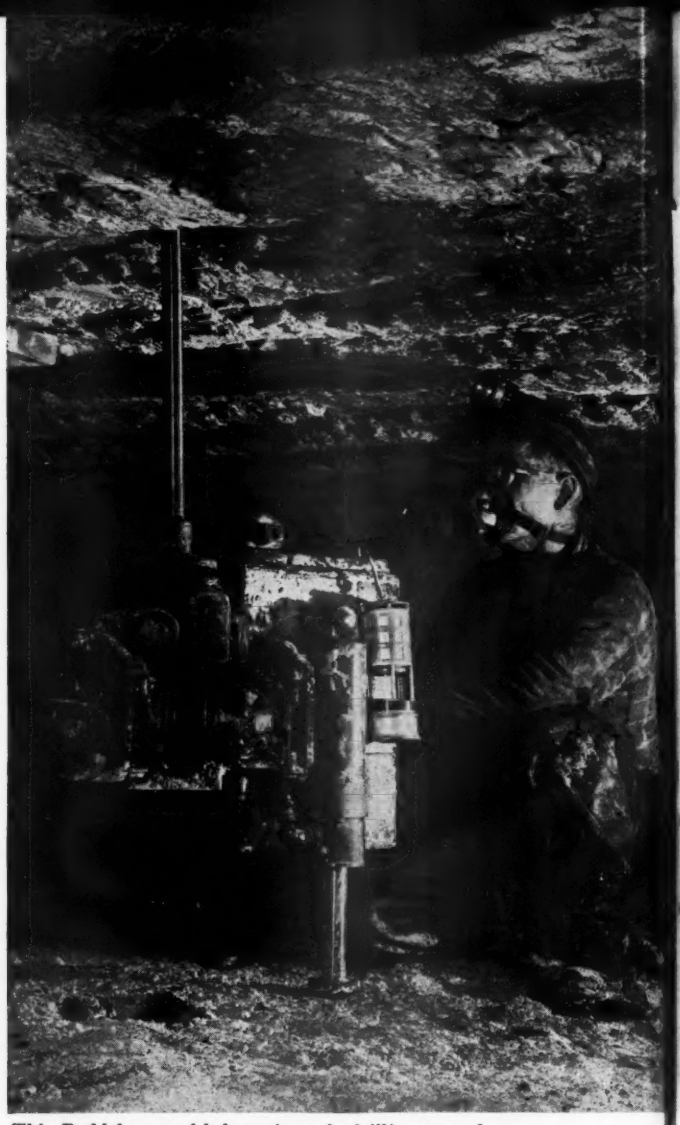
It should be pointed out, however, that more reliance is placed on quantities such as man-hours, equipment hours, kilowatt hours, units of product, etc., than on dollars because dollar values are influenced too often by uncontrollable factors.

This does not mean to say, however, that we are not aware that the final measure of success is whether or not a pound of lead or a pound of zinc can be produced and shipped to a customer at a profit—after taxes.

Methods and procedures, utilization of manpower and materials, division of responsibility and authority—in all of these there has been improvement over what existed six years ago and this can be proved by lower costs per unit of product. But—there is one thing that the writer is absolutely sure of—all the Ph.D.'s, electronic computers, consultants, and popular alphabetical magic, O.R., I.E., etc., are only the tools for the diagnostician. They may help to write the correct prescription but it's going to take some bitter medicine to effect a complete cure if a company's biggest problems are finding employes willing to do a day's work with ability to do the job; and teaching supervisors how to have the right man, the best tools and all the materials needed on the job the minute a machine is released from production.

In conclusion, the success of the Plant Services Division could never have been achieved without full cooperation from all other divisions. Good lines of communication are essential, but probably equally important is a management that has insisted on people operating within the framework of their established responsibility and authority, to minimize confusion in direction of effort, and to recognize responsibility for achievement.

Let a Bethlehem engineer show you what roof bolts can do



This Bethlehem roof bolt engineer is drilling to make a test installation in a coal mine. Besides increasing protection against rock fall, Bethlehem roof bolts will also assure maximum headroom and haulageway clearances.

Steel

for Strength
... Economy
... Versatility

Bethlehem roof bolts minimize the danger of roof falls because they grip the strata, with the great strength of steel, to keep roof and walls in place.

A Bethlehem engineer will consult with you, without obligation. He will make tests in the strata to determine whether the rock lends itself to bolting. And he'll help to get your bolting crews started properly.

For the full story, get in touch with the nearest Bethlehem sales office. Or write to us at Bethlehem, Pa.

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AMC COAL DIVISION CONFERENCE 1961

Coal Division Committees Report On Year's Work

WHEN THE SUN SET ON PITTSBURGH, PA., Friday, November 17, it rang down the curtain on the finest Coal Division Conference since the series of meetings began some 30 years ago. Well over 400 representatives of the mining industry were on hand to listen to the highlights of committee work during the past year, and to take part in the discussion which followed each report.

The Coal Division Committees are made up of mine operators and representatives of mining equipment manufacturers who work together to advance all phases of mining technology. The committees are constantly gathering information to keep abreast of new developments, new ideas and new concepts that offer promise in advancing the art of coal mining and preparation. The Annual Conference, held in the fall, is designed to bring the mining industry as a whole abreast of these advances.

A highlight of the meeting was the Annual Luncheon which is held in honor of the Coal Division Committee chairmen. It was presided over by Jesse F. Core, U. S. Steel Corp., who is the Chairman of the Coal Division. Feature speaker at the luncheon was William H. Stringer, Washington Bureau Chief of the Christian Science Monitor, who spoke about an American's responsibility in the world today.

Following is a digest of the day's reports.

COMMITTEE ON MINE POWER

JAMES A. ERSKINE,
Eastern Gas and Fuel Associates,
Chairman

THE FIRST REPORT of the day, "Cables and Cable Accessories for A–C Mining," was presented by Mike Kopchik, Jr., Rome Cable Div., Aluminum Co. of America. Kopchik distributed copies of the recently completed, "Specification for High Voltage Portable Cables, Type SHD and SHD-GC." The specification, to be published in an early issue of **Mining Congress Journal,** covers three-conductor, rubber-insulated, shielded, neoprene-jacketed, portable power cables with grounding conductors, including type SHD and SHD–GC in sizes 6 to 4/0 AWG, for use on dredges, electric shovels, portable substations and other portable mining equipment. These cables are for nominal alternating current voltages of 3 to 15 kv, grounded neutral, and are of the following two classes:

Type SHD—With three grounding conductors
Type SHD-GC—With two grounding conductors and one ground-check conductor

It is expected that this specification will be of considerable value to both manufacturers and users of portable power cables.

Frank R. Hugus, Joy Manufacturing Co., reported for the committee on "Improving Trailing Cable Performance" and reviewed the development of the committee's information on cable failure. At the 1960 AMC Coal Convention in Pittsburgh, a paper was presented by the subcommittee which showed the need for trailing cable failure data, and a program of data collection and analysis was begun. A good number of questionnaires have been returned, and the data contained thereon has been transferred to IBM cards for analysis. Although it is too early to draw conclusions, two trends seem to be developing: (1) splices are involved in more cable failures than any other factor; and (2) there are twice as many failures between conductors as there are between conductors and ground.

A suggested AMC standard, Graphical Symbols for Electrical Diagrams in the Mining Industry, was then presented by Jim Erskine. The standard will be of considerable help to those in the industry who work with electrical symbols.

John Buss, Reliance Electric Co., presented an informal discussion of the effect of permissibility decisions on the development of mining equipment. Federal law requires that any new regulations or changes to existing regulations be published in the Federal Register. The public then has 30 days to offer comment or criticism, after which, the Bureau, at its own discretion may republish the schedule as a final regulation. This procedure has caused some concern in the past since the 30-day period often does not provide enough time to all concerned to give careful consideration to new regulations. Buss pointed out that the Bureau has been extremely fair in granting an audience to anyone wishing to comment on a proposed schedule and the committee expressed confidence in the Bureau's fine work.

* * *

COMMITTEE ON ROOF ACTION

L. D. ELLISON,
Island Creek Coal Co.
Chairman

D. F. CRICKMER, Pocahontas Land Corp., reviewed the findings revealed in the study of "The Cost of Supporting Mine Roof."

He said that comparing mine costs, or even the costs on separate sections in a mine, is a difficult task. The main problems are the variables. Height, conditions, and types of equipment are but a few of the variables encountered when comparing mining costs.

To be able to arrive at a variance in cost per ton between good top, average top, and bad top, certain conditions must be met. It is agreed that more coal will be produced in good conditions than in average or bad conditions. In addition to producing less coal in average or bad condi-

Average Roof Support costs in various seam heights

	HEIGHT RANGE											
	30" to 40"			40" to 50"			50" to 60"			60" & Over		
	Good Top	Avg. Top	Bad Top	Good Top	Avg. Top	Bad Top	Good Top	Avg. Top	Bad Top	Good Top	Avg. Top	Bad Top
Roof Support Crew	1	2	4	1	2	4	1	2	4	1	2	4
Additional Face Crew	9	9	9	9	9	9	9	9	9	9	9	9
Total Union Labor	10	11	13	10	11	13	10	11	13	10	11	13
Union Labor Cost per Ton	$ 0.73	$ 0.93	$ 1.47	$ 0.48	$ 0.62	$ 0.92	$ 0.38	$ 0.49	$ 0.78	$ 0.28	$ 0.36	$ 0.60
Production per Section per Shift (Tons)	342	296	228	542	453	348	650	567	427	929	756	562
Miners Vacation, Unemployment, Social Security, etc.	25.00	28.00	33.00	25.00	28.00	33.00	25.00	28.00	33.00	25.00	28.00	33.00
Supervision	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00	40.00
Cost per Ton	0.19	0.23	0.32	0.12	0.15	0.21	0.10	0.12	0.17	0.07	0.09	0.13
Total Labor Cost per Ton	0.92	1.16	1.79	0.60	0.77	1.15	0.48	0.61	0.95	0.35	0.45	0.73
SUPPLY COST												
Roof Support Materials	0.05	0.24	0.47	0.05	0.20	0.41	0.05	0.19	0.40	0.05	0.17	0.36
Maint. of Roof Support Equip.		0.04	0.05		0.03	0.04		0.02	0.03		0.01	0.02
Supply Cost per Ton	0.05	0.28	0.52	0.05	0.23	0.45	0.05	0.21	0.43	0.05	0.18	0.38
Grand Total Cost per Ton	0.97	1.44	2.31	0.65	1.00	1.60	0.53	0.82	1.38	0.40	0.63	1.11
Variance from Good Top		0.47	1.34		0.35	0.95		0.47	0.85		0.23	0.71
Variance from Average Top			0.87			0.60			0.56			0.48

tions more manpower and equipment is required to control the roof.

The cost sheet on the opposite page sets up a form which can be used to develop a cost for good, average, or bad top conditions. By filling in the spaces to satisfy particular manpower needs, a dollar-per-day figure for labor becomes available. This cost, divided by the produced tonnage under the various tops, will give the labor cost per ton. The same procedure applies to the supply cost. Information contained in the form is a composite based on data provided by seven coal producers from various sections of the country.

The cost comparison chart is not intended to bring the cost variance in line, but it is intended to set forth a form where each mine will be able to use the same basis for calculating cost.

Following the Crickmer report, Frank L. Gaddy, C&O Railway Co., reviewed the progress of the subcommittee for "Standard Specifications of Roof Bolting Materials." The committee has been trying to develop a standard method of indicating the size of expansion shells.

* * *

COMMITTEE ON MINE RESEARCH

H. B. CHARMBURY,
Pennsylvania State University,
Chairman

THE COMMITTEE ON MINE RESEARCH was organized in June of this year. At the organization meeting in Pittsburgh it was concluded that the committee, in addition to its other functions, should foster good relations with other research groups, and avoid conflict with utilization groups by concentrating on various phases of research pertaining to coal production.

To encourage more coal research the committee asked the newly established Office of Coal Research of the Department of the Interior to outline its functions at the November 17 meeting in Pittsburgh. As a result, Wayne A. McCurdy, Chief, Division of Mining and Preparation, presented the paper, "Functions of the Office of Coal Research." McCurdy highlighted the short history of the office since its organization this year, and developed its purpose and its methods of promoting new uses for coal through research. Coal men, remembering from experience how the so-called assured markets for coal, such as the domestic and railroad market were lost, must continue to look for better methods of coal production and utilization. The OCR has received 160 proposals for research projects to date.

Short term projects that will be of immediate help to the coal industry is the office's chief interest rather than long term projects such as many sponsored by the U.S.B.M. Because of this difference, and since the office does not own its own research facilities, no conflict is expected with the Bureau. While new uses for coal is of prime importance, the fields of mining and preparation will not be neglected. Any improvement in these areas will be of value to the industry and certainly make coal more competitive. The chief function of the OCR staff will be to evaluate proposals. Since the staff will not conduct the research all research will be performed under contract with the office. Areas for possible investigation may be (a) transportation of coal; (b) recovery of chemicals from coal; (c) exploitation of steel-making markets; (d) development of smaller industrial heating plants; (e) gasification and liquid fuels; (f) coal preparation as it affects "a" through "e"; and (g) promotion of coal use in electric power generation.

A larger market for coal is a potential; it will be realized through hard work on the part of the coal industry together with vision reflected in research and development.

* * *

COMMITTEE ON MINE SAFETY

WOODS G. TALMAN,
U. S. Steel Corp.,
Chairman

WOODS TALMAN emphasized that since the committee was organized it has devoted itself to an "engineering approach" to safety. For the last several committee meetings the use of fire-resistant hydraulic fluids has been under study. Talman called on C. W. Parisi, Pittsburg Coal Co., to present the committee's carefully prepared review of the work to date and its position regarding the future use of fire-resistant hydraulic fluids.

Parisi recalled how the committee began its study in September 1960 with a tour of the U.S.B.M. hydraulic fluid laboratory in Pittsburgh. At a meeting held in Pittsburgh in March 1960, reports were received from several selected mine operators. Some of these operators recommended the new fluids, others were having trouble with their use. During September 1961 a poll of five of the major equipment manufacturers was conducted to learn their attitude on the new fluids. The manufacturers were not for or against their use but some cautioned they could not guarantee any of their equipment if operated with the new fluids.

As a result of its investigation during the past year-and-a-half, the AMC Committee on Mine Safety has arrived at the following conclusions:

1. Inverted emulsions are fire-resistant.

2. Inverted emulsions have been used successfully by some mine operators as a hydraulic fluid. A side benefit has been decreased consumption because the characteristic milky color makes leaks easier to spot.

3. An element in making inverted emulsions work that can't be overlooked is the desire to make them work.

4. The use of inverted emulsions has often led to increased wear in the hydraulic system—and, in some instances, to poorer machine performance.

5. The performance of inverted emulsions has improved since they were first introduced. Two factors enter into this improvement—better emulsions and a better understanding of their use by the coal industry.

6. There are problems yet to be solved in the use of inverted emulsions —especially in high pressure hydrostatic power circuits which are subject to severe service.

7. The introduction of inverted emulsions may dictate that the hydraulic system of mining machine be revamped. Some coal operators have found this to be advantageous even though they haven't converted to emulsions.

8. The time has not yet arrived when the use of fire-resistant hydraulic fluids should be required in underground operations.

The Committee recommends that:

1. Every encouragement should be given to continued experimentation with inverted emulsions and the development of emulsions and hydraulic systems that are compatible.

2. Mine operator, machine manufacturer and petroleum supplier should cooperate closely to hasten the day that fire-resistant fluids can be recommended without reservation.

In conclusion, Parisi said the committee is pleased at the progress that is being made in the introduction of fire-resistant hydraulic fluids. He commended the Bureau of Mines and the suppliers of petroleum products for their efforts to develop and perfect these fluids. He said, "We are optimistic that the close cooperation of all parties concerned will lead to continued improvements, which will widen application in coal mining."

* * *

COMMITTEE ON MECHANICAL MINING

JAMES A. YOUNKINS,
Duquesne Light Co.,
Chairman

JAMES A. YOUNKINS described the committee's recent work on the study of the control of dust in continuous mining sections. Early in 1961 the Committee visited the experimental mine of the U.S.B.M. to see a demonstration of how a dust explosion could be propagated even if a dust analysis showed more than 65 percent incombustible material. This demonstrated the need to control float dust in mining operations. Although progress has been made in reducing float dust by the use of water sprays and with auxiliary ventilation, the problem still needs serious and continuing study.

John Osmanski, Island Creek Coal Co., chairman of the subcommittee on "Predicting the Performance of Continuous Miner Operators" reviewed the study and announced plans to conduct a similar study for selection of mine maintenance personnel. The miner operator study based on test scores from over 150 men in three companies refuted many factors formerly thought to be of prime importance in continuous miner operator selection. Factors such as being an old timer in mining, a former machine operator, and a high school graduate were among those found unimportant. It is hoped that the forthcoming maintenance study will be equally as informative.

Victor A. Hurley, Hurley & Hinks, told the Conference that his recently organized subcommittee aims to determine how the coal industry buys and controls the cost of mine lubricants. This is but the first step in a series of studies by the group on cost control methods.

* * *

COMMITTEE ON COAL PREPARATION

J. J. REILLY,
Jones & Laughlin Steel Corp.,
Chairman

FILTERING WAS DISCUSSED BY P. L. RICHARDS, U. S. Steel Corp., who reviewed the highlights of a meeting on the subject which was held by the Preparation Committee in Charleston last March. Methods of handling tailings and products from froth flotation circuits were discussed and the following points were emphasized: (1) A filter cake has to be of a consistency that allows it to be scraped from the filter media; (2) disc filters have more filtering area for a given area of floor space; and (3) flocculents can improve filter performance.

Richard L. Mullins, Enos Coal Mining Co., discussed the problem of preparation plant maintenance, also using information presented at a committee meeting in 1961—this one in Louisville last August. The subject was divided into three areas: Materials used to build new plants, planning for new plant construction, and reducing the maintenance cost of established plants. Often, to reduce capital costs, materials are specified for new construction that must be replaced later with more expensive, longer lived, products. Better planning and proper selection of new plant materials will reduce maintenance costs. Maintenance costs at established plants can be reduced by the use of new corrosion resistant and abrasion resistant materials.

* * *

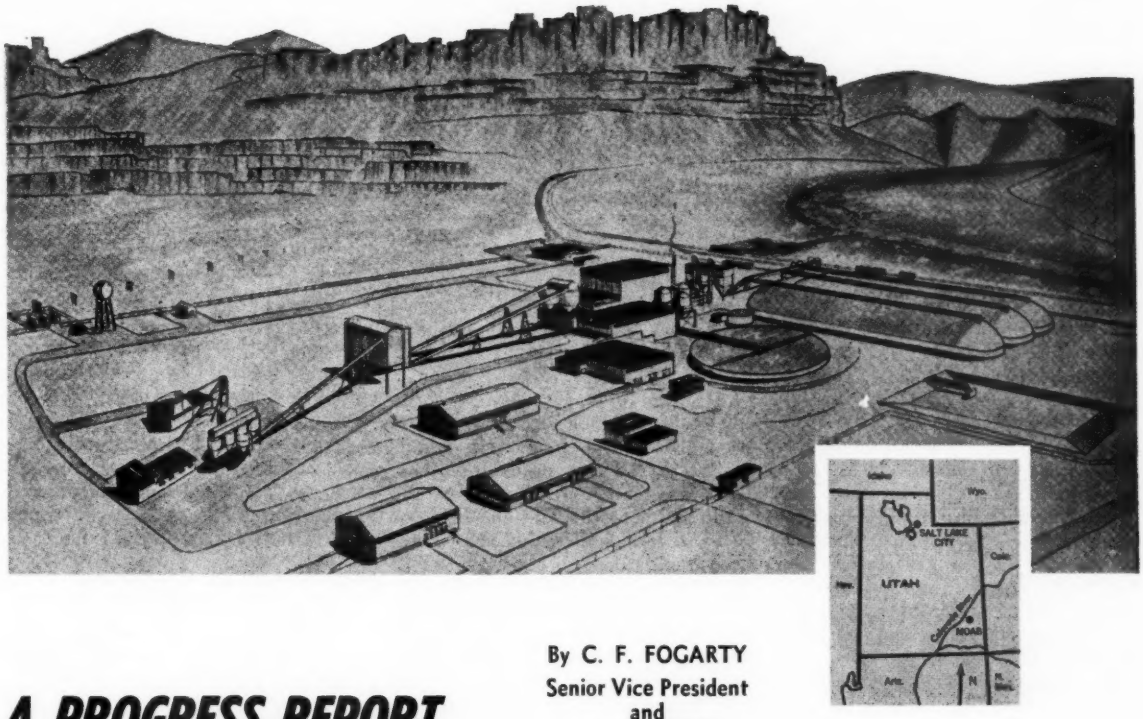
COMMITTEE ON MINE HAULAGE

A. G. GOSSARD,
Snow Hill Coal Corp.,
Chairman

ROBERT DREISBACH, General Electric Co., reported on the development by his subcommittee of the revision of the "Safety Code for Coal Mine Transportation." This code, American Standard M-15–1931, has not been altered since 1931. Dreisbach submitted a detailed report based on the work of the committee. The progress report on the revised standard covers mine cars, electric locomotives, diesel and diesel electric locomotives, animal haulage, overhead power systems for electric locomotives, and roadbed, track, and signals for all the above types of equipment. The standard also includes safe operating procedures for the above equipment, and safe operating procedures for the underground transportations of explosives. The standard is not yet complete, but the sections remaining to be revised should be finished during the coming year.

* * *

Texas Gulf Sulphur Company's New Potash Project



A PROGRESS REPORT

By C. F. FOGARTY
Senior Vice President
and
F. E. TIPPIE
Project Manager
Texas Gulf Sulphur Co., Inc.

ONE of the most significant mineral developments in the Western Hemisphere is now taking shape near Moab in southeastern Utah, where a single mine and mill will produce muriate of potash at a rate of more than 3000 tpd. Total capital expenditures to develop and bring the Cane Creek potash deposit into production are estimated to be in the order of $30,000,000. The decision marks Texas Gulf Sulphur's first major diversification in the industrial minerals field.

Two Commercial Beds Known in Cane Creek Area

The Cane Creek potash deposit is located along a gentle anticlinal structure within the Paradox Basin. There are numerous such salt structures trending northwest to southeast within the Basin, but regional studies have indicated the Cane Creek anticline to be the most favorable from the standpoint of depth, grade, and minability.

The Cane Creek structure is located near the western edge of the potash basin, and thus has not undergone the intensive salt folding so common in other areas. The salt beds are Pennsylvanian in age, and three potash beds are known within the Cane Creek area. A fourth bed, known to be present in the Seven Mile area, is also believed to be present in the Cane Creek area.

In the Cane Creek area, only two of the upper beds are now considered to be commercial. The upper bed has been thoroughly defined, and at present, development work is planned only

The concrete headframe at the Cane Creek mine was poured to a height of 123 ft in ten days using the continuous slip-form method of construction. The plant site area is shown in the background where about 700,000 yd of material had to be excavated to clear the site for construction

for this bed. However, the lower bed has been cored in many of the test holes, and is known to be very extensive and of even higher grade.

Potash has been known to exist in the Paradox Basin for many decades. The Crescent Eagle well, drilled in Salt Valley in 1925, reported significant showings of potash. The Midwest Exploration Co. wells on the Cane Creek anticline also reported showings. In the 1940's, active exploration for potash was in progress in the Salt Valley area. Indications from extensive drilling were unfavorable for the development of a major potash deposit.

In 1952, Delhi-Taylor Oil Corp. started drilling the Seven Mile area northwest of Moab, and outlined large minable deposits. In 1956, Dehli-Taylor geologists, on examining a gamma ray-neutron log of an oil test recently completed on top of the Cane Creek anticline, recognized strong indications of a substantial potash bed occurring at a minable depth. After securing potash prospecting permits covering the area, Delhi-Taylor spudded in its first test in December 1956. Results were so favorable that they discontinued work on the Seven Mile area and subsequently drilled eight tests on the Cane Creek structure.

Texas Gulf Sulphur Co. optioned the property in April 1960 and during the next four months completed nine confirmation and development wells and outlined a large, high-grade deposit of sylvinite ore. Drilling indicated a very simple and gentle anticlinal structure, not complicated by salt solution and the resulting collapse and faulting, as was indicated in the Salt Valley area.

Air Used as Drilling Medium

In order to expedite the test drilling, latest oil field techniques were used. The major innovation contributing to the rate of drilling these holes was the use of air as a drilling medium instead of mud and brine or fuel oil. It is understood that Texas Gulf was the first to core salt or potash using air as a drilling medium.

The following general pattern was used in drilling the test holes. One or two joints of 8⅝-in. conductor pipe were set and cemented in a 10¾-in. hole. Out from under this conductor pipe, a 7⅞-in. hole was drilled to the top of the salt series, where a string of 5½-in. casing was set with an expandable-type packer in such a manner that the casing could be recovered. This packer was usually set in an anhydrite bed just above the salt series, and in all cases but one, a tight seal was achieved. In the one exception, cement was pumped behind several joints of the casing and the packer and these were left in the hole on abandoning. The remainder of the test hole was drilled and cored with a 4¾-in. bit. With few exceptions, two 820-cfm compressors were used with a booster to increase pressure when necessary. This system provided ample air volumes for holes slightly in excess of 4000 ft. Generally, the booster compressor was not necessary. Operating pressures ranged from 175 to 250 psi.

Core recovery was good to excellent while coring with air. The main advantage of air drilling and coring was the tremendous increase in rate of penetration. Where previously, with the use of mud through the upper section and brine or fuel oil in the salt section, 3500 to 4000 ft holes were requiring two to three months for completion; through use of air as both a drilling and coring medium, 4000-ft holes were completed in as little as 18 days.

The use of air eliminated leaching of the cores, as was often the case when using brine. The resulting cores from air drilling were clean and uncontaminated; ideal for analysis and metallurgical tests.

The resulting time reduction also reduced drilling costs, for all drilling was done on a day-rate basis. Though air costs were almost equal to rig costs, there was still a considerable saving of money as well as time.

All wells were logged with gamma ray-neutron logs and directional surveys. Cores of potash zones, after being described in detail by company geologists, were sent to the Colorado School of Mines Research Foundation for detailed chemical analysis and metallurgical testing.

All wells were plugged with neat cement from bottom to top after pulling the 5½-in. casing and Larkin packer, as an insurance against possible water leakage in the future.

Shaft Site Core-Drilled Before Sinking

On the basis of the drilling, structural and isopach maps and detailed cross sections were prepared to evaluate fully the ore reserves and the minability of the ore. This information, when combined with chemical analyses and metallurgical data, resulted in a very favorable summation and in exercise of the option by Texas Gulf. Prior to the latter, a pilot hole for the shaft was started. This well was unique in that it was cored from 72 ft to a depth of 2830 ft, 20 ft below the top of the salt.

The pilot hole was drilled on down to the first potash bed, which was cored in the straight hole and in four whipstock (deflected) holes. These cores were taken to obtain ore for special crushing tests. Diamond bits were used to cut a 7¾-in. hole and to take a four-in. core. Twenty-two bits were used, and core recovery was 93.5 percent. All potential water zones, however small, were tested by drill stem tests. All core from the shaft section was carefully logged

and stored in inclined core racks in a special building. All of this core is neatly laid out for examination during sinking operations.

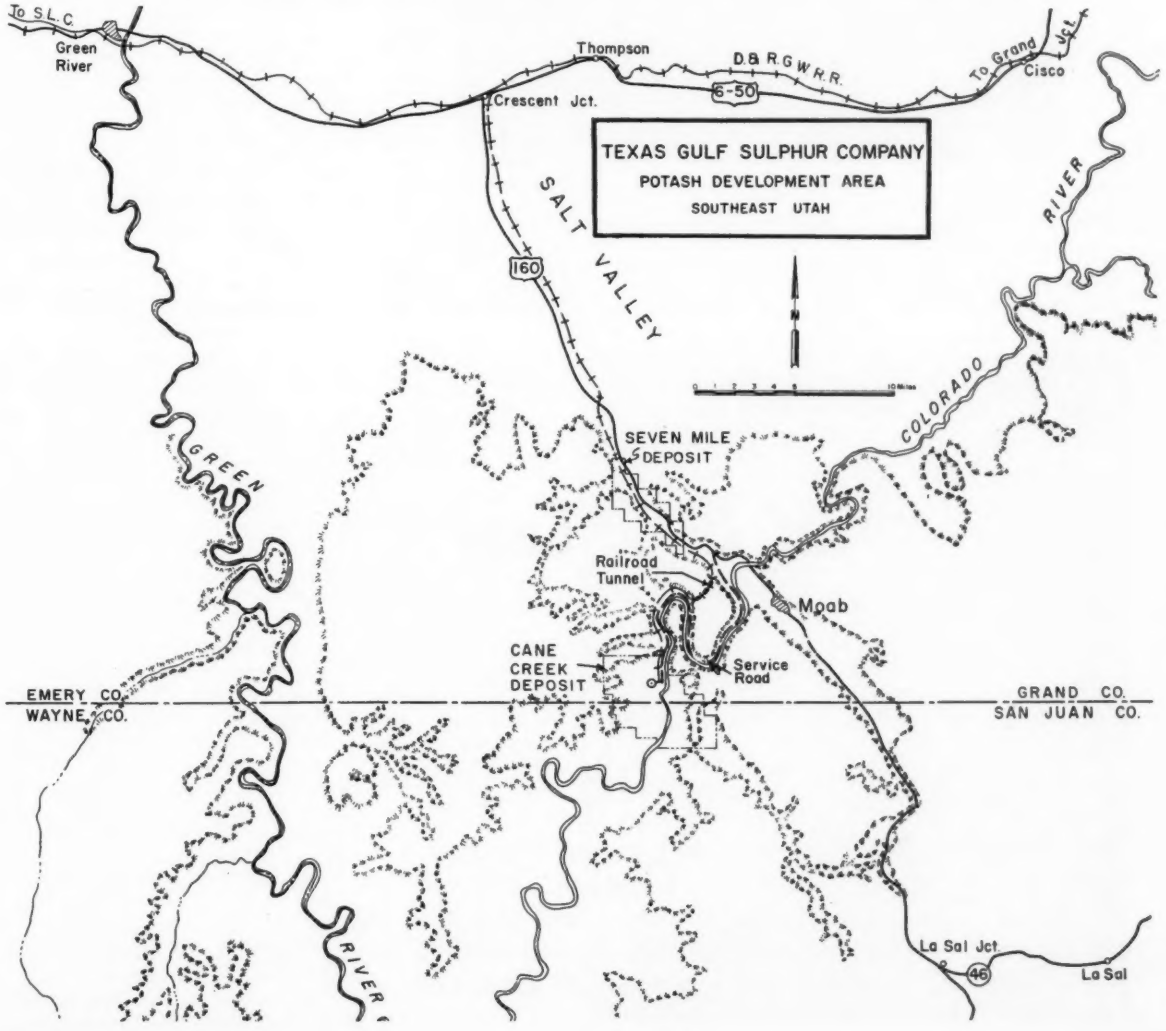
Due to the extreme topographic relief overlying the deposit and to the large aerial extent of the engineering work contemplated, it was decided that, rather than to establish a conventional local control survey, a survey system would be established which would provide control of all the works involved. Accordingly, a triangulation control system, based on the U. S. Coast and Geodetic Survey System for the State of Utah, and of high second order, was established, and is now in use for both horizontal and vertical survey control. It has proven its worth from an economic and engineering standpoint, and has been expanded to include the railroad tunnel control and the railroad alignment as well as other engineering and geological studies, including the Seven Mile area.

Headframe Built Using Slip-Form Method

After extensive study by consultants from Colorado School of Mines Research Foundation and Behre Dolbear & Co. and by Texas Gulf engineers, a shaft location was agreed upon. It was difficult to find a location near a suitable plant-site location in this area of extremely rugged terrain. The area finally chosen for the plant-site and railroad yards, adjacent to the shaft, will require in excess of 700,000 cu yd of excavation.

Stearns-Roger Manufacturing Co. of Denver was awarded the contract for the surface design and construction, including a concrete headframe and the shaft and collar to a depth of about 70 ft. The initial blast for the shaft collar and headframe was on February 23. The shaft was concreted to a depth of 60 ft and the collar and headframe foundation completed by May 10. It then took ten days to pour the headframe to a height of 123 ft above the ground. This structure was poured, using the continuous slip form method, where the forms are hydraulically leveled with jacks, which are in turn attached to smooth reinforcing bars set in the concrete. The rate of rise of the slip forms was six to seven in. per hour. All work including placement of steel reinforcing, pouring and finishing of concrete continued 24 hours per day as the form was rising. Slip forming was used up to the rope deck. Work is still proceeding above, and the hoist deck has been poured. On completion, an estimated 3500 yd of concrete and 200 tons of reinforcing steel will have gone into the headframe.

(continued on page 60)



The miners are repairing timber sets in a haulage road 3000 ft below the surface in a Krupp colliery. Thinner seams and poor mining conditions make European coal expensive to produce

German Imports of U. S. Coal

By OMER ANDERSON
Correspondent in Germany

Oil is capturing an ever-increasing part of the European energy market. However, European Coal and Steel Community experts expect quotas and discriminatory duties will eventually be dropped, and predict that American coal will win a permanent European market

THE European Coal and Steel Community is congratulating itself on the fact that the ECSC is producing less coal. It is doing it by reducing work hours and closing marginal pits.

At the same time the ECSC is producing more steel. Production for 1961 is expected to reach 75,000,000 tons—80 percent higher than in the first year of the ECSC a decade ago.

Ten years after the coal and steel pool came into being it finds the steel industry expanding at unprecedented rate. Coal consumption is shrinking at almost the reverse rate.

The ECSC is trying to grapple with the "realities" of the European energy situation, the "realities" being that coal is losing ground fast to petroleum. And beyond petroleum there is nuclear energy, which the six nations of the coal and steel pool already have organized to exploit through the European Atomic Energy Community (Euratom).

This is the rather somber background against which any analysis of the prospects for future American coal shipments to Europe must be projected.

However, the same economic forces which have produced the ECSC's coal glut also promise long range to provide a stable market for American coal imports.

Uneconomic ECSC Mines to be Closed

ECSC countries, and particularly West Germany, are in the process of reorganizing their national coal industries to make coal respsonsive to normal economic pressures.

This means that the various ECSC governments are abandoning, albeit slowly and reluctantly, efforts to support coal production and consumption as national economic policy. Rather, government support now is directed toward shucking off controls and subsidies which have artificially stimulated uneconomic coal production.

With the energy market unfettered, U. S. coal will be able to compete for the ECSC market on more or less economic terms. ECSC coal experts predict that American coal, once quotas and discriminatory duties are dropped, will win a permanent European market.

There seems no possibility the European market will ever reach the former record of 37,000,00 tons of U. S. coal imported in 1957, but the market should be steady, if modest.

This new trend in European government policy toward coal is dramatized

by the Bonn government's plans to establish a "coal authority," but this authority will not regulate production and fix prices—just the contrary. It will buy up and close out marginal mines, and will work generally to rationalize German coal production.

Coal is to be made competitive with petroleum to the extent this is possible. Otherwise, Ruhr coal is to be deliberately doomed.

Since July 1958 the Germans have closed, wholly or partially, 18 mines. Some 130,000 miners have been taken out of the pits permanently and retrained for non-coal jobs, principally in industry.

The result has been an amazing spurt in productivity. The remaining 416,000 miners (of which an indeterminate large number also will be taken out of the mines) are producing more coal than did the total miner force of 546,000 in 1958 and before. West German production will rise from 142,000,000 tons in 1960 to 143,500,000 in 1961.

The ECSC last year produced 1,000,000 tons less of coal because of the closing of marginal mines and shortening hours of work. But coal will supply only 50 percent of the community's consumption of energy in the current year against 71 percent in 1950.

There is increasing evidence, nevertheless, that the coal problem is being solved, although several years more will be required. Latest available figures show that stocks at the pitheads, totaling 27,000,000 tons, still exceed those at the end of 1958 and are four times as great as 1957—but they have fallen by some 4,000,000 tons since the end of 1959.

In West Germany stocks at the pithead, which in June 1960 approached 13,000,000 tons, are now down to less than 7,000,000 tons. There has been a slow steady rise in French pithead stocks, from 12,000,000 to 13,000,000 tons over the last year, but about half of this total comprised low-grade coal. Underground workers in French mines today number 20,000 less than three years ago. For some months now France, like Germany, has not had to shorten work hours.

The drastic but inevitable task of closing the uneconomic Belgian mines will take more time. But it is well under way with the aid of ECSC funds and a strict limitation of imports. Underground workers have been reduced from 110,000 to 80,000 since the end of 1957. Pithead stocks have diminished by about 1,000,000 tons in the last 12 months.

There was never a serious problem for Dutch mines, and there are virtually no Italian coal mines.

The Council for the Organization for European Economic Cooperation has been focusing on European coal problems. In January 1960 the OEEC's Energy Advisory Commission drafted its report, "Toward a New Energy Pattern in Europe." Since then the OEEC has been telling its member governments that they should permit, as far as possible, the application of a more flexible price policy for coal and should encourage the development of marketing and the transformation of coal into secondary forms of energy.

The OEEC has just issued a series of conclusions concerning the European energy outlook for the guidance of its member states. Long term energy policy, advises the OEEC, should be based on the assumption that there will not be any lasting shortage of energy supplies in Western Europe before 1975.

Energy policy, according to the OEEC, should attach the utmost importance to securing plentiful supplies of low-cost energy, at the same time leaving the consumer the greatest possible freedom of choice. Everything should be encouraged that may lead to a more rational use of energy.

Governments should permit, as far as possible, the application of a more flexible price policy for coal. Better methods of marketing energy, especially coal, should be encouraged. The greatest importance should be attached to the transformation of coal into secondary forms of energy.

Government generally should refrain from preventing sound economic management of production, transport and distribution of the different forms of energy.

Improved demand combined with a cutback in output have reduced by 9,000,000 metric tons in the last year the unsold stocks of Western Europe's coal mines. Pithead stocks rose by 22,000,000 metric tons in 1959 to total 67,000,000 metric tons by the end of that year, but they had dropped to 58,000,000 metric tons by the end of 1960.

Britain, with 29,800,000 metric tons, had the largest supply of unsold coal at the mines at the end of 1960, followed by France with 13,300,000 metric tons and West Germany with 7,100,000.

Europe, excluding the Soviet Union, produced a total of 590,000,000 metric tons of coal in 1960, a drop of 7,000,000 metric tons from 1959.

Meanwhile, the Ruhr coal mines are confronted with a new problem: they fear increased British competition if Britain joins the Common Market. They expect that their sales in North German coastal areas especially will be affected.

Ruhr mines will embark on new investments amounting to $750,000,000, despite the uncertain sales position for

More European miners will be retrained for other work as uneconomic mines are closed. Some 130,000 miners have already been taken out of the pits permanently and retrained for non-coal jobs

Marginal mines are being shutdown in Europe, and large amounts of money are being spent to modernize the remaining operations

coal. Of this amount, $463,000,000 will be used for modernization and sinking new shafts, $188,000,000 for power plants near the mines, and $90,000,000 for coking plants.

Thus, the spectacular steel boom, the ECSC High Authority's moves for a thoroughgoing reorganization of the Belgian coal industry, and measures to restore a reasonable balance of supply and demand on the Community market, brought a notable improvement in the European coal situation during 1960.

This improvement has continued, albeit slowly, during 1961. The main evidence of the improvement was provided by the steady fall in pithead coal stocks and a sharp decrease in part-time work in the mines.

ECSC countries will import 12,000,000 metric tons of American coal in 1961, of which West Germany will take around 5,000,000 metric tons (the quota imposed by the Germans on U. S. coal imports for the years 1961 and 1962).

Germany Duty Free Import Quota Raised to 6,000,000 tons

The Germans intend continuing to impose the 20-mark ($5) per ton duty on imported coal at least through 1962. However, the duty-free import quota was expanded by 800,000 tons —to 6,000,000 tons—for 1961 and it is expected to be expanded still further in 1962 and in succeeding years.

This means that the quota could well rise to 8,000,000 tons for 1962, with the U. S. share rising to around 6,500,000 (and Britain getting the lion's share of the remainder).

Although the Germans probably will retain the 20-mark per ton duty for the foreseeable future, it is likely that economic pressures generated by the government's new policy of "realism" will force upward revision of quotas.

One such factor is the German currency revaluation of last March, which boosted the value of the mark from 23 cents to 25 cents. This has improved the competitive position of American coal in the German market to even greater degree than is suggested by five percent revaluation.

Those German export industries pinched by the Deutschemark revaluation are demanding that the duty be taken off American coal to compensate them for the loss of their competitive advantage in the export markets.

This is particularly true of the shipbuilding industry in north Germany. In general, German industry demands that the government, now that the German currency has been boosted in value, refrain from further tinkering with the prices of such basic raw materials as coal, that German coal be made completely competitive with foreign coal.

The German currency revaluation has considerably strengthened U. S. coal's competitive position in the German market. U. S. coal continues to under-sell Ruhr coal in north Germany, where it is widely used by utilities.

As the marginal Ruhr mines are closed, the Ruhr's entire industrial outlook is undergoing reorientation. Once an area synonomous with coal and steel production, the Ruhr is being gradually transformed into an area of diversified general industry.

The state of Northrhine Westphalia, in which the Ruhr lies, has formed a state-sponsored "industrial development board," which seeks to attract foreign industry, primarily U. S. and Canadian, to the Ruhr.

Foreign firms are offered attractive plant sites and assistance in hiring skilled labor (much of it retrained coal mine manpower). There are tax concessions and plant location loans.

All of which means that as the German coal industry is "rationalized," made competitive with foreign coal, the industry becomes less of a political force, and coal less a pillar of the Ruhr, if not entire general Germany, economy.

As Ruhr coal's political importance diminishes, so diminish the political pressures directed toward the exclusion of U. S. coal from the German and general ECSC market.

Offsetting these trends favoring rising American coal imports are, of course, the increasing productivity of German mines and the steady loss of the European coal energy market to petroleum. As German coal is "rationalized," it will become increasingly competitive with American coal.

On balance, therefore, most experts forecast an indefinite German market for U. S. coal varying between 5,000,000 and 12,000,000 tons through 1975. Radical shifts in the economies of either Europe or the U. S. could alter these figures, but projecting current trends into 1975, the experts believe this forecast will prove reasonably accurate.

The ECSC market for U. S. coal closely parallels the German market, which, in fact, accounts for almost half the total American coal shipments to the ECSC countries.

It is believed that the ECSC, overall, will provide a market for around 12,000,000 to 20,000,000 tons of U. S. coal annually into 1975. The range forecast is necessarily wide because of the question mark over atomic energy.

Atomic Energy Has Proved Disappointing

So far atomic energy has proved disappointing to the ECSC nations, its generation costing substantially more than power generation with conventional fuels.

The current forecasts for hard-coal (Steinkohle) production potential in the years ahead are lower than those given in the ECSC's 1960 survey, which in turn were lower than the 1959 and 1958 figures.

A further drop is possible, but the 252,000,000 metric tons indicated for 1964 may be set against the coal and steel community's 1960 consumption of 250,000,000, of which 98,000,000 was accounted for by the coking plants and 43,000,000 by the power stations. Sales outlets for coal are becoming more and more concentrated on electricity production and the iron and steel industry.

If coal's share in the production of thermal current still stands at 62 percent in 1964, with that production increased to 251 billion kwh and specific consumption reduced to 0.4 kg/kwh, consumption by the Community power stations should reach a total of approximately 63,000,000 metric tons.

The maximum production of the coking plants in 1964, given 96 percent utilization of their aggregate production potential, may be expected to work out at about 87,000,000 metric tons. This would represent an input of about 113,000,000 metric tons of coking coal.

It is unlikely that demand for coke consumers outside the iron and steel industry will remain at its 1959 and 1960 level of approximately 25,000,000 metric tons. This would mean that a least 62,000,000 to 63,000,000 metric tons were available for the iron and steel industry, which would cover the maximum requirements now indicated for the blast-furnaces and sintering plants.

Investment in the Community's steel plants suggests a maximum crude steel production in 1964 of 91,500,000 metric tons (given 96 percent utilization of potential).

Aside from the ECSC's importation of U. S. coal, the U. S. Army is buying about 305,000 metric tons of coal from U. S. producers for use by the American Armed Forces in Europe. In the past the U. S. Armed Forces purchased mainly European coal.

But the Army is now buying coal for the Armed Forces use in Europe only from firms that get their coal supplies from the United States. The Defense Department program to cut foreign purchases overseas permits buying U. S. source material if the estimated price, including transportation and handling, is no more than 125 percent the cost of foreign materials (25 percent more than the foreign-produced material).

The Army is also considering the possibility of obtaining U. S.—source coking coal in Europe, converting it in Germany and distributing it to U. S. military installations in Europe within the cost percentage allowed.

However, on the basis of previous offerings there is doubt the entire requirement could be filled by offers of coal from U. S. sources. About 1,028,000 metric tons of coking coal are required to fill the annual requirement in Europe for 720,000 metric tons of coke.

British Steel Industry Wants to Import More U. S. Coal

Meantime, the British steel industry is still campaigning to force the British government to permit the wide-open importation of American coal. The Steel Company of Wales, which consumes about 2,000,000 tons of coal per year or one percent of total British output, is leading the "buy American" drive.

U. S. coal sells in Britain for about 30 shillings ($4.20) a ton cheaper than British coal. Britain's Iron and

West German stocks are less than 7,000,000 tons, down from 13,000,000 tons in mid-1960. While Germany intends to retain the $5 per ton import duty on coal, the duty-free import quota might well rise to 8,000,000 tons in 1962, with the U. S. share rising to 6,500,000 tons

Steel Board has taken this position on the issue: "We attach great importance to the availability of fuel to the United Kingdom iron and steel industry at prices that are competitive with those secured by other steelmakers abroad. The future competitive position of the industry is vitally dependent on securing competitively-priced coal."

Britain's National Coal Board agrees that some American coal can be brought across the Atlantic more cheaply than it could be bought from British pits, largely because of depressed shipping rates.

British steel producers are pointing to the fact that their Continental competitors are deriving a substantial advantage by receiving cheaper American coal. Last year, France imported 738,000 tons and this year is boosting the figure to nearly 1,000,000 tons; Italy took more than 4,750,000 tons in 1960 and this year is receiving around 5,000,000 tons.

The outlook for American coal shipments to Europe was summarized by Sir Julian Pode, managing director of the Steel Company of Wales. He said, "British steel producers intend to press for the right to buy unlimited quantities of American coal, so long as this coal can be purchased cheaper than that offered in this country (Britain).

"The British steel industry can survive only by remaining competitive with the world steel industry, even as British industry can survive in world markets only by staying competitive with foreign firms.

"That is the lesson we have had to learn, and, unfortunately it is the lesson the British coal producers will have to learn. There is no room for charity in the modern international business world, either on a national or private basis.

" 'Buy British,' means nothing to us if the price is higher than we can obtain the same material or item abroad. This is the harsh fact of international business life."

TEXAS GULF SULPHUR COMPANY'S NEW POTASH PROJECT—A PROGRESS REPORT

(continued from page 55)

Mine Will Have Fully Automatic Hoists

Harrison International was selected as the shaft contractor in April and the shaft was turned over to them on June 29. Harrison will sink the shaft to a depth of 2800 ft, cut stations, prepare ore pockets, underground storage and drive two crosscuts, each for a distance of 2800 ft, to interesect the ore body.

Shaft sinking equipment comprises two double-drum hoists operating four buckets to the bottom through a four-deck Galloway stage. Sinking and concreting are carried on simultaneously. The Galloway stage is operated from a triple-drum hoist incorporating the stage suspension cables as rope guides for the muck buckets.

The shaft will be 22 ft in diam and fully lined with concrete. A concrete divider wall will separate the upcast side from the downcast side. Multirope Koepe type hoists will be used for both production and men and materials. Rope guides have been approved for the ore skips and the mancage.

The production hoist, with a designed capacity of 667 tph, will operate two 20-ton skips in balance. The service hoist, operating with cage and counterweight in balance, is designed to carry 80 men per trip. Both hoists can be operated fully automatically.

Metallurgical tests were conducted at the Colorado School of Mines Research Foundation on the ore recovered by coring the test wells. A final flowsheet was prepared by Texas Gulf Sulphur engineers. Inasmuch as sylvite is the only potash mineral present in the ore, and there is a complete absence of clay minerals, no problems are expected in treating this ore. The plant is being designed in 4000-ton units, and the initial installation will consist of two such units. Some of the initial equipment installations are being designed to handle 12,000 tpd to allow for later expansion. Wherever possible, the most modern innovations will be used in this plant.

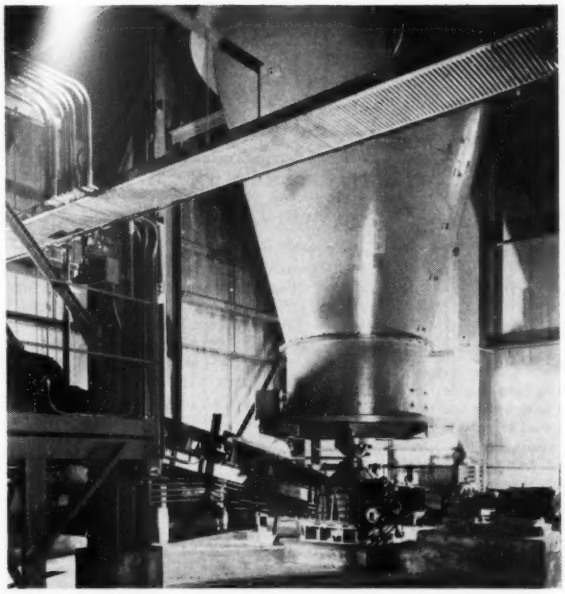
36 Mile Rail Spur to Serve Plant

One of the major problems of the project has been access. A new paved highway is under construction from U. S. Highway 160, three miles northwest of Moab, down the Colorado River Canyon along the north bank of the river to Dead Horse Point State Park. This road will pass the plant site. The railroad offered a more difficult problem.

Numerous routes were studied to bring the railroad from the main line of the Denver & Rio Grande Western at an elevation of 4800 ft at Crescent Junction to the plant site located in the canyon of the Colorado River at an elevation of 3965 ft. The final plans are to follow U. S. Highway 160 from Crescent Junction down Moab Canyon, but at a much lower grade than the existing highway. The maximum grade on the spur line is to be 1.2 percent. On reaching the Colorado River valley, the line will enter a 7200-ft tunnel through the canyon wall, again joining the river about five miles above the plant site. The total length of the spur will be 36 miles.

Construction work on all phases of this project is now in progress. If the schedule is maintained, production should be achieved by the end of 1962, and the company will be able to enter the market during the 1962–63 fertilizer year. By the 1964–65 fertilizer year, it is expected that production will be at a rate of 1,100,000 tons of muriate per year.

"The worst part about my husband thinking he is a Geiger counter is that his 'clicking' is getting on my nerves."



One of four storage bins for fine concentrates with 8½-ft diam table feeder, drive, receiving belt, and weighing scale. The floor in this area is sloped at about ⅜ in. per foot to allow cleaning with water using a minimum of labor.

GRATE-KILN PELLETIZING PROCESS AT HUMBOLDT

By ROBERT W. BERKHAHN
Operating Metallurgist
and
DANIEL M. URICH
Pyrometallurgist
The Cleveland-Cliffs Iron Co.

"THE plant has reached capacity production and the quality of pellets is unexcelled in the industry." This statement, from the 1960 Annual Report of The Cleveland-Cliffs Iron Co., is one measure of the success that has accompanied application of the grate-kiln system to the processing of low-grade iron ores at the Humboldt mine.

Humboldt Mining Co. is jointly owned by Ford Motor Co. and The Cleveland-Cliffs Iron Co. The Humboldt mine is located on the Marquette Range, approximately 14 miles west of Ishpeming, Mich. Production of 2000 LT of pellets per day from this fully integrated operation—low grade crude ore to high quality pellets—began in July 1960. Because of the impact of mining and concentrating on the pelletizing process, it is felt that a brief discussion of these phases is warranted.

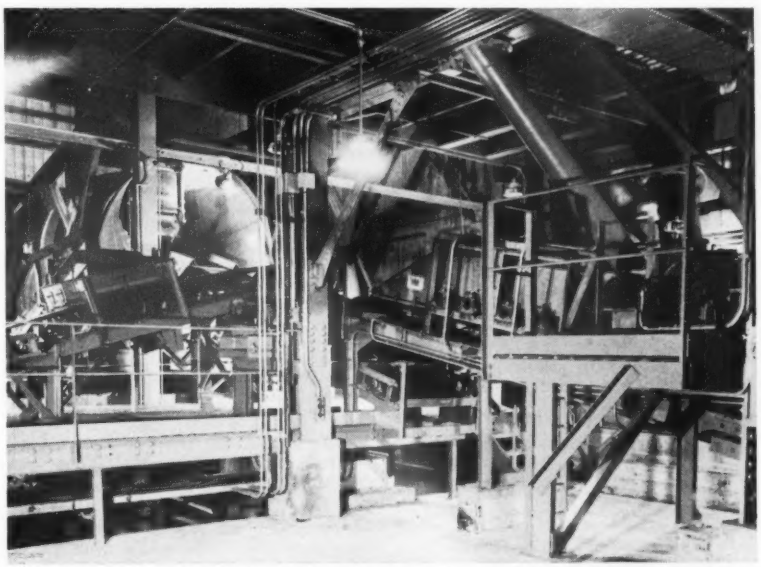
Concentration of specular hematite, using the flotation process, began at Humboldt in 1954 with the completion of a concentrating plant which produced approximately 650 LT of concentrate per day. Subsequent equipment additions in 1954 and 1955 increased the plant's capacity to approximately 1000 LT of concentrate per day. This final product, having a consistency too fine for use in the blast furnace, was sintered at Ford's Rouge plant.

In 1958 design work began on an expansion to the crushing and concentrating facilities, and on a 2000 LT per day ACL grate-kiln pelletizing plant. Construction of these facilities was completed in mid-1960.

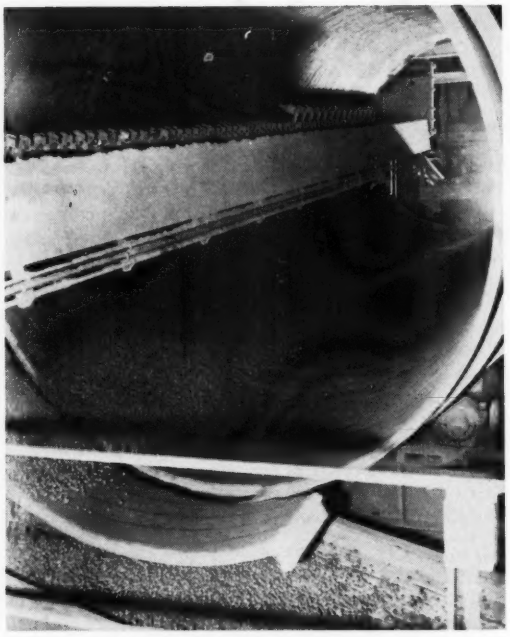
Mining of Humboldt Ore Dates from 1864

Iron ore mining is nothing new in the Humboldt area. Underground mining operations were conducted in a number of relatively small mines in the Humboldt ore body from 1864 through 1920 on an intermittent basis. The aggregate tonnage of high grade, direct shipping ores produced by the various properties during this period was slightly over 1,300,000 tons. In 1888, Thomas Edison experimented with a process of separating the ore from the rock with a "magnet-electro" machine. This work was curtailed when the building housing the magnetic separators was destroyed by a fire. The old reports indicate that a highly acceptable concentrate of magnetite was made by this early attempt at beneficiating Humboldt ores.

The Humboldt crude ore is a low



Reel-type mixers (center) blend the moist reground concentrates with bentonite prior to balling in the balling drum (left center). Circulating load of undersize pellets and fines join the new feed from the cross conveyor (left center)



The 9 ft by 30 ft balling drums have a normal output of 30 long tons of green pellets per hour when operating at 12 rpm. The serrated discharge lip on the drum serves to distribute the pellets over the width of the vibrating seed screen (foreground) that feeds pellets onto the traveling grate

Product	% Wt	% Fe	% Fe Recovery
Crude	100.00	27.9	100.00
Slime	3.75	20.4	2.74
Flotation feed	96.25	28.2	97.26
Flotation concentrate	37.88	62.4	84.7
Flotation tailing	58.37	6.0	12.6

Fig. 1. CONCENTRATOR METALLURGICAL BALANCE

grade mixture of cherty specular hematite and magnetite with minor martite and sericite. The iron oxides occur as bands of varying thickness in the chert and in some areas the oxide mineralization occurs as an extremely fine grained variety disseminated throughout the chert bands. The overburden covering the ore body varies in depth from bare outcrops to 50 ft at some points in the pit and in character from fine sand to massive boulders. The ore body is approximately 1300 ft long and varies in thickness from 250 to 400 ft.

Mining is accomplished by conventional open pit methods employing jet piercing as the primary ore drill, supplemented by a rotary drill using nine-in. tungsten carbide Tricone bits for rock drilling. Broken ore is loaded by five-yd electric shovels into 40-ton diesel powered trucks for haulage to the crushing plant. There, the crude cherty ore is reduced to rod mill feed size of a nominal ½ in. in three stages of crushing in open circuit.

Six Steps of Processing Before Pelletizing

The six major steps in the processing of the crude ore ahead of the pelletizing operation can be summarized as follows:

Grinding and classification. Crude ore is reduced by open circuit rod milling from ½ in. to eight mesh and ball milling in closed circuit with a hydroscillator classifier. The classifier overflow contains approximately 1.5 percent plus 65 mesh with 65 percent passing 200 mesh.

Desliming. The hydroscillator overflow is deslimed prior to reagentizing at a 20 micron split using two stages of cyclones in series. Approximately four percent of the crude ore weight, representing about three percent of the total iron units, is discarded as a slime tailing.

Conditioning. The underflow from the desliming cyclones is discharged by gravity at 65 percent to 70 percent solids into the conditioner cells arranged in series for the desired conditioning time. Stage addition of approximately 1.50 lb of tall oil fatty acids per ton of float feed is made in the conditioners. Other reagents used are: 0.005 lb per ton of Aerosol OT-75 which is added to the primary cyclone underflow, and 0.05 lb per ton of frother added to the last conditioner cell.

Flotation. The flotation circuits consist of three stages of flotation; roughing, cleaning, and recleaning, with the final concentrate grade being obtained in the recleaner stage. The rougher tailing is pumped to a row of scavenger cells which produce a final tailing and a scavenger concentrate. The scavenger concentrate plus the cleaner and recleaner cell tailings are directed to a scavenger cleaner machine which produces a concentrate which is recycled to the head of the flotation circuit along with the new feed (figure 1). The plant crude for this period is approximately 2.5 percent lower in iron content than the average Humboldt crude.

Thickening & Filtration. Flotation concentrate is pumped to a thickener with the thickener underflow being filtered.

Regrind. The flotation concentrate is 45 percent minus 325 mesh. It is necessary to regrind the concentrate to at least 75 percent minus 325 mesh to form the moist "green balls" in the balling section of the pelletizing plant. Moisture control is as important to the balling operation as concentrate fineness. The reground concentrate is filtered to contain 9.0 percent to 9.5 percent moisture—careful control of the moisture at this level is imperative. All phases of the operation ahead of the pelletizing plant are directed toward delivery of a high grade concentrate of sufficient fineness that will permit operation of the pellet plant at peak capacity. Most of the problems are inherent in the mining of a relatively narrow ore body which has considerable variation in 1) iron content, 2) type of iron mineral—hematite, magnetite, and martite, and 3) natural grain size of the iron minerals. The mine operator and the concentrator operator must do their best to level out these variables ahead of the pellet plant. With the addition of pelletizing facilities at Humboldt, the concept of the concentrator operation has changed to that of a feed preparation section for the pellet plant.

Two 1000 tpd Units Make Up Pelletizing System

Plant design called for an annual capacity of approximately 646,000 LT. Plant operation is on a three shift per day, seven days per week basis. There are no scheduled downtime shifts on a weekly basis. Maintenance work of a major nature (refractory, fans) is normally done on a monthly or bi-monthly basis.

Two identical, 1000 tpd units are installed. The primary pieces of equipment are: (1) chain type traveling grate, (2) rotary kiln, and (3) rotary, annuler cooler. These items were designed and supplied by Allis Chalmers Manufacturing Co. Plant layout, design and erection were done by the Arthur G. McKee Co.

The plant was completed in mid-1960, and Unit No. 1 began operation on July 1. No. 2 unit started on August 30. The separated starting dates were beneficial in that the contractor's men were available for both major and minor alterations to the system.

A refractory failure in the cooler forced a shutdown after only two days of operation. After this correction, the plant reached its designed capacity in about six days. Minor changes and alterations were then made while the unit was operating.

Some of the minor problems encountered during start-up were normal, such as conveyor belt tracking,

alignment of balling drum carrying rollers, positioning of feed chutes, relocating belt skirting, recalibration of instrumentation, and replacing motor heaters, etc.

Both McKee and Allis Chalmers supplied technicians, as well as engineering personnel, during all phases of the plant start-up and training sessions. In addition, manufacturers of some of the larger equipment had representatives available as instructors during the training program.

Preheated pellets on the traveling grate are removed by stainless steel stripper castings in the transition zone between the grate and kiln. The shelf behind the stripper castings allows build-up of pellets to protect the castings from hot exit gases leaving the kiln

Training Program Preceded Start-Up

The key operators and shift supervisors were selected from a list of employes who were unemployed due to cut backs in the company's underground mines. This "cadre" was selected on the basis of both aptitude and general I.Q. tests, and previous work habits, plus personal interviews. Ten men were included in this group.

These people were hired in April 1960 and attended training sessions seven hours a day, five days a week. At least one hour each day was spent touring and inspecting the plant equipment. Some of the subjects covered were:

1. **Sequence of starting eqiupment**
2. **Equipment speeds and limits of operation**
3. **Safety**
4. **Equipment lubrication**
5. **Principles of combustion**
6. **Theory of pellet formation and induration**
7. **Heat transfer principles**
8. **Temperature limits of metal parts**
9. **Refractory installation and use**
10. **Boiler operation**
11. **Emergency shutdown procedures**
12. **Dust collector operation**
13. **Bentonite and oil unloading systems**
14. **Electrical interlocking**
15. **Instrument operation and limits**
16. **Flow schemes in material handling**

These subjects were introduced and taught by personnel from McKee, Allis-Chalmers, Cleveland-Cliffs and some equipment suppliers. The equipment concerned was inspected in detail and question and answer or discussion sessions normally took place within the plant.

Additional training was conducted at a cement plant utilizing the grate kiln system and by visiting Reserve Mining Company's Silver Bay pelletizing plant. Both the Cleveland-Cliffs pilot plant (grate-kiln) and the Eagle Mills pellet plant (updraft grate) were visited and inspected. The trainees had ample time to talk to plant operating personnel and to inspect operating procedures.

The final phase of the training program was normally done after the contractors had left the property each evening. During these sessions, equipment was started and allowed to run for periods of up to four hours. Each man covered every phase of the plant in this manner and was at least familiar with each piece of equipment and its normal operation.

The training program had much to do with the orderly, efficient start-up accompanied by a notable lack of broken or burned out equipment. These same men now have the responsibility for the plant operation.

Gravity Transfer of Material Employed

The pellet plant is totally enclosed in a structure 340 ft long and 133 ft wide at its widest point. The minimum width is in the kiln section where the building narrows to 56 ft. The maximum height of the building in the balling area is about 115 ft, whereas in the cooler-kiln control area it is only 55 ft above grade. Raising the feed end of the plant is necessitated by the gravity transfer of hot pellets into the kiln, passage through the kiln, dropping from the kiln into the cooler and dumping from the cooler into the vibrating feeders.

Reground concentrate is conveyed to the top of four 450 LT storage bins by a 24 in. wide belt which dumps onto a 30 in. wide, reversible, remotely controlled shuttle belt. This storage is ample for about 14 hours of normal operation, should a belt be stopped for repairs.

The reground concentrate is fed from the bottom of each bin by an 8½ ft table feeder driven by a ten-

Pellets discharge from the kiln firing hood (above) into the annular cooler which is constructed of super duty fireclay brick. The normal depth of pellets on the cooler pallets is 30 in. Ambient air blown up through the bed of hot pellets cools them and recuperates their heat for use as secondary air in the kiln. Banded side wall has been modified since picture was taken. Vertical baffle wall separates the cooler feed area from the cooler discharge area

hp d-c motor, whose speed is controlled by an instrument which also weighs the concentrate and proportions the additives.

The additive storage bins have a nominal capacity of 85 LT of bentonite and 180 LT of limestone. There is one bentonite and one limestone bin for each of the four balling circuits. Reel type mixers are used to blend the dry bentonite with the moist reground concentrate prior to the balling operation.

Each balling circuit consists of a 9 ft by 30 ft balling drum, a 5 ft by 14 ft vibrating screen and the associated conveyor equipment to return the minus $\frac{3}{8}$ in. undersize green pellets to the balling drum along with the new feed. The oversize from the screen (plus $\frac{3}{8}$ in.) feeds onto a conveyor, is weighed and combined with the product from another balling circuit. The green pellets are then transported onto an oscillating conveyor which has a shuttle type head pulley, and distributed in an even layer on a 111 in. wide belt. From the wide belt they are fed over a 9 ft 4 in. by 9 ft 7 in. pellet feeder vibrating screen. This screen removes the minus $\frac{1}{4}$ in. fines and conveys the plus $\frac{1}{4}$ in. pellets onto the grate machine. The undersize from the screen is fed to the fines handling system.

The green pellets move through the drying zone of the grate machine which consists of three windboxes representing 40 percent of the total active grate area of 518 sq ft. The remaining 60 percent is in the preheat zone. The grate machine has 71 ft centers.

After the pellets are heated to approximately 2000°F in the preheat zone, they pass through a refractory lined transition chute between the grate and the 10 ft by 120 ft rotary kiln.

Pellets Heated to 2450°F in Kiln

The kiln is fired with No. 6 oil with a maximum burner capacity of 500 gph. Approximately 25 percent of air necessary for combination is supplied through this burner. The secondary air for combustion rises through the firing hood into the kiln. This secondary air is heated while passing through the hot bed of pellets within the cooler.

The pellets, which are heated to approximately 2450°F in the kiln, discharge into a 25 ft diam annular rotating cooler which has a pallet width of 4 ft 4 in. The normal bed depth of pellets over these pallets is about 30 in. Ambient air is blown updraft through this hot bed of pellets to 1) cool the pellets, and 2) to recuperate heat from the pellets for use as secondary combustion air within the kiln. A baffle wall separates the loading point of the cooler from the discharge end. Each pallet is keyed to a shaft which is positioned by an arm riding a stationary rail along the periphery of the cooler. The moving part of the cooler is driven by a sprocket chain assembly and two motors spaced 180° apart on the outside circumference. The moving part of the cooler rotates at one revolution in 45 minutes.

The pellets discharge from the cooler onto vibrating feeders. These feeders serve to minimize surging of fired pellets onto the exiting conveyors and also convey the cool, fired pellets. A grizzly on the end of the feeder bypasses any chunks formed in the kiln.

A conveyor system transports the pellet product to a railroad loading pocket or to a stacker, which places the pellets in stockpile.

Elaborate Gas Handling System

A unique feature of the grate-kiln system is the multiple use of gases (air + combustion products). Ambient air is blown into the primary cooling zone of the cooler where it is heated to about 1700° F by passing upward through the bed of hot pellets. This preheated air is directed into the kiln for use as secondary combustion air. Upon leaving the feed end of the kiln, these gases pass up into the preheat furnace over the grate. They are next pulled downward through the bed by the No. 1 process air fan. This fan will pull approximately 100,000 cfm at 10 in. SP and 750° F. Prior to reaching the No. 1 fan, the flow is directed into eight refractory-lined, cyclone type, dust collectors. After being cleaned and passed through the No. 1 fan, the air flows into the drying furnace over the grates. These gases are pulled downward through the grate again by the No. 2 process air fan. The No. 2 fan

(*continued on page 68*)

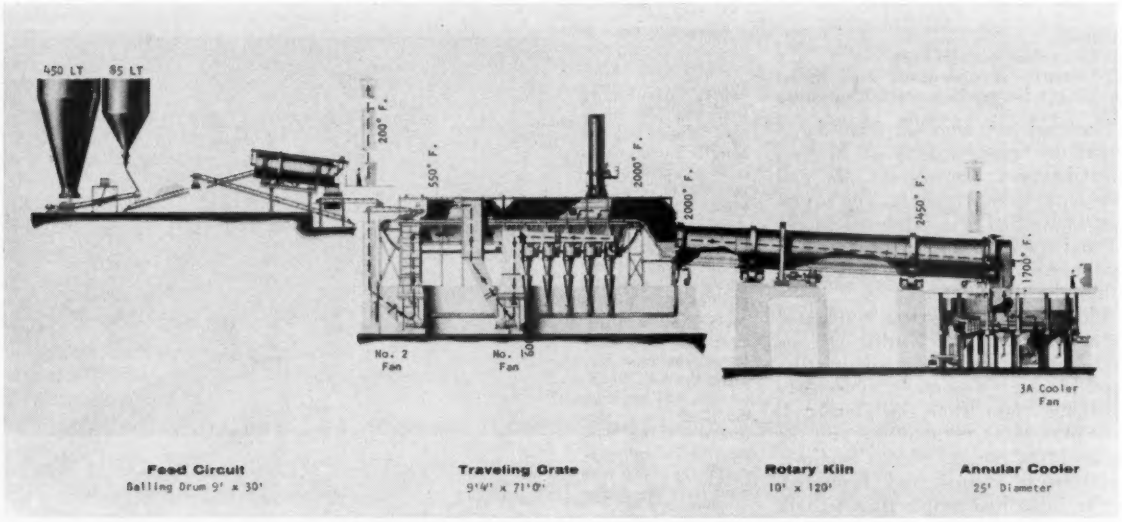


Fig. 2. Components of the grate kiln system employed at the Humboldt mine. The system uses fuel oil in the heating process and does not require the admixture of fuel in the pellets

Increasing Equipment Availability Through Maintenance

Decreasing equipment downtime is the joint responsibility of manufacturers and operators

By THOMAS P. BRADFORD
Lubrication Engineer
Hanna Coal Co.

THE title of this article confines it to a specific area, yet at the same time leaves room to cover a very important field extensively. The considerations given here apply equally to one piece of equipment as well as hundreds of units.

As an introduction it is necessary to consider intangibles.

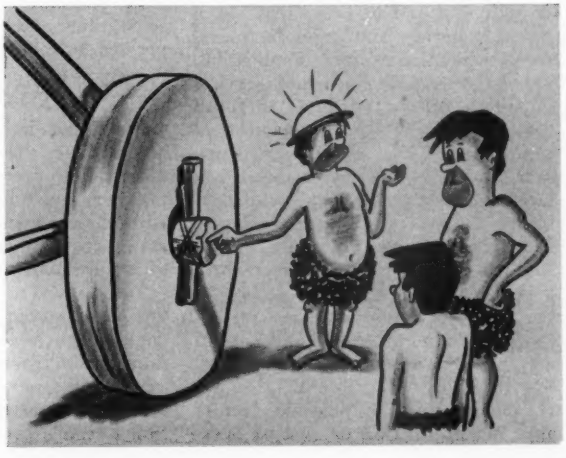
The objective is availability; increased production resulting in lower per unit cost. The means to attain this is a plan or basic application, which in this instance is maintenance.

Usually when we think of the term maintenance of equipment it is associated with the actual operation of that equipment and to a specific maintenance program applied by management. Results start with the manufacturer and/or his distributor when establishing a good maintenance program.

Availability will be decreased if equipment is purchased that has a recognized weakness in basic design. The same is true if equipment is purchased with time consuming replacement problems incorporated in the basic design, or if service is provided by an inadequate distributor.

Similarly, availability is decreased if equipment is operated at a production capacity which was overrated by the manufacturer or in an improper application recommended by the manufacturer. Failure in any one of these areas results in decreased availability, discounting any maintenance program. These failures must be attributed to the manufacturer or his representative. However, many times a reflection is cast on the maintenance program or operation of the equipment. As a result, the maintenance and operating personnel adopt a defeatist attitude which reflects deeper into the efficiency of the maintenance effort. Thus, availability is a joint responsibility.

Preventive maintenance is important



Good supervision is a vital part of any maintenance program

Don't overload equipment or it will fail

Maintenance must be broken down into two basic programs and treated as such to attain increased availability. These programs are preventive maintenance and corrective maintenance.

Preventive Maintenance Originates With Manufacturers

Preventive maintenance is the key to the success or failure of any operation and maintenance program. The manufacturer and distributor have a joint responsibility in some respects. Sound engineering, including practical application, must be evident in their recommendations to the customer. Experience gained through a trial-and-error method by the customer is not conducive to increased availability. Equipment today is designed by the manufacturer to meet the average requirements of application and conditions encountered in the market.

Each customer having multiple applications and conditions elects to purchase a piece of equipment to meet average needs, yet versatile enough that it can be utilized in a general sense. The manufacturers' recommendations for application, preventive maintenance and service, if sound, will be adequate to fulfill the customers' needs in the average utilization of this equipment. However, a proper preventive maintenance program must be designed with flexibility to meet conditions deviating from the average. Therefore, under average operating conditions, in an average application and following the manufacturers average recommendations, a customer should attain maximum availability and production.

Consider all the possible factors affecting production or cost of operating a piece of equipment including expected cost (Ec)—average operating conditions (AOC) — average application (AA) — manufacturers' recommendations for preventive maintenance (MRPM) — parts and service (PS)—customer preventive maintenance program (CPM)—actual production (x)—competent operating personnel (CP)—below average rating (–)—above average rating (+) and maximum availability (MA).

The perfect relationship of these factors to assure maximum availability, assuming the manufacturer and distributor fulfilling their responsibilities correctly, might be expressed as follows:

$$AOC \cdot AA \cdot MRP \cdot CP \cdot PS = MA \cdot MRP \cdot EC$$

When the factors change this does not hold true. The relationship must then be changed to read the objective. The factors vitally affecting this relationship are operating conditions, applications, operator and production rating.

If operating conditions were more severe the conditions might be expressed as follows:

$$(-)\ AOC \cdot AA \cdot (+)\ MRPM \cdot CP \cdot PS \cdot (+)\ CPM = MA \cdot MRP \cdot EC$$

Note that if operating conditions are adverse, the manufacturer's recommended preventive maintenance program must be increased by substituting our own preventive maintenance program, in addition, in order to attain the original objective.

If more severe operating conditions are encountered the result will be decreased availability, lower production and increased cost. The only answer to this is to recognize the need for more competent personnel in addition to more preventive maintenance over and above the amount the manufacturer has recommended. Certain severe applications where normal production is in excess of design may require, in addition to the increased personnel competency and preventive maintenance, a decrease in productivity in order to attain the best unit cost. More cannot be expected from a piece of equipment than was designed into it without paying a premium for the additional results. An ideal preventive maintenance program evaluates the factors and their relationship then takes steps to correct the problem.

The following may be concluded, up to this point, with respect to preventive maintenance:

1. **It originates with the manufacturer and distributor**
2. **The customer must evalute his average need and expected result, prior to his purchase.**
3. **All factors, relative to the objectives in any good preventive maintenance program must be recognized, evaluated and corrected.**

How to Establish, Operate and Maintain a Good Program

Preventive maintenance as it applies to the operation of equipment might be defined as follows: "The proper adjustment and timely replacement of necessary integral parts prior to their failure." To delay in this timely replacement may often mean a chain reaction accelerating premature failure of associated parts.

As a simple illustration, many people today would allow the infection of a finger to cause the loss of an arm, because of failure to treat it properly or amputate at the proper time. Sounds ridiculous, yet how many mechanics would allow an entire engine to fail because they did not properly treat or remove the oil filters, or change the oil, or adjust bearings?

The primary function of a good preventive maintenance program is attending to maintenance details at the proper time. Too often production gets priority and a machine is not made available for preventive maintenance when it should have been. The important question at this point is how to establish, operate and maintain a good preventive maintenance program. We can deal only in generalities, offering food for thought. Each preventive maintenance program, since it involves details, is peculiar to its respective application or need.

The only tools manufacturers, managers, or owners of equipment have

to work with are the personnel under their direction. The results of their efforts must be measured by the success or failure obtained from selling a program to those who must carry it out. A desire to cooperate may be either created or destroyed in those to whom the responsibility is delegated. Therefore, if a preventive maintenance program is to be successful with the most economical expenditure, it must depend on those to whom we delegate the responsibility and to what extent they will accept and carry out their assignment.

The initial step of course begins with the operators and immediate managers of the equipment. In most instances, with the proper training experience, tools and facilities, an adequate preventive maintenance program can be successfully carried out by the operators and operating management. This is provided, of course, they are sold on such a program and properly trained.

Use the correct tool for each job

When equipment is out of service for preventive maintenance, unless there is a spare unit, operating people are available for maintenance. This is ideal also, from the standpoint that much of the preventive maintenance program is in the hands of the operating management and operating personnel. Such factors as operating conditions, application of equipment, competent personnel and inspection are directly related to operation.

If spare equipment is available, in order to attain maximum availability, it may be advisable to perform mechanical and physical preventive maintenance during idle time with properly trained maintenance personnel. In any such program operating personnel should not lose sight of their responsibility with respect to preventive maintenance. To do so would increase the need for additional preventive maintenance personnel, thus increasing preventive maintenance cost.

These references are pointed out merely to emphasize the fact that each preventive maintenance program must be carried out in the most effective manner. Consideration has to be given to the particular application, with the program being adapted to the need, not the need to the program, in order to achieve the objective.

What Does the Term Corrective Maintenance Mean?

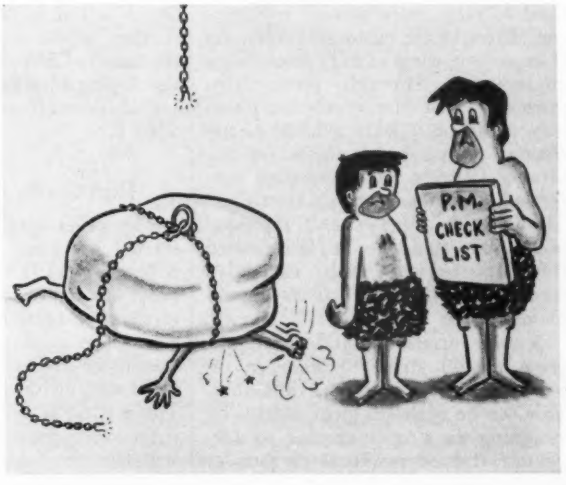
Even with an adequate and economical preventive maintenance program, a point is reached where major components have fulfilled their life expectancy from natural causes. It is now time to take corrective action of replacement by way of rebuilding.

The manufacturer, having the ability to design integral parts of equipment which will have everlasting qualities with the proper preventive maintenance program, will eliminate his competition in a short time.

The preventive maintenance program aims to assure the full life expectancy designed into each part and the unit as a whole. The corrective maintenance program succeeds the preventive maintenance program when required. In the corrective maintenance program is in the preventive maintenance program, the operator is closely associated with the manufacturer. When rebuilding or renewing main component parts, the operator should benefit from the latest developments in design and research. This means the operator must be kept informed on the latest developments through the medium of service bulletins, letters, schooling and technically qualified personnel. It also means parts must be supplied that incorporate the latest design.

A properly established corrective maintenance program will frequently have qualified personnel conducting various test and evaluating programs aimed at increasing component life. These investigation programs can also be aimed at a determination of the most economical part or component to use. A good corrective maintenance program should incorporate two vitally important basic functions. First, an attempt to analyze the cause of failures, and second, apply corrective measures.

The first step in analyzing failures should be to endeavor to detect any failure of the preventive maintenance program as a contributing factor. This of course includes the equipment application and operating procedures, as well as actual preventive maintenance application mechanically. First design, material assembly, etc., must be examined in an endeavor to make



Use check lists as part of regular safety inspections

an honest evaluation of the cause of failure. After the cause of failure has been determined, a corrective measure must be applied, to avoid useless repetition of such failure. This corrective measure may come from the operators, or the manufacturers' recommended preventive maintenance program, or it may come from the manufacturers' and/or distributors' engineering services.

The source of the corrective measure is irrelevant as long as the action produces results. The following experience at Hanna Coal Co. illustrates the importance of these two basic functions of a good corrective maintenance program.

A dozer was clearing heavy timber, and during the process the headlights were broken off during the day-shift operation. Since the dozer operated on the afternoon shift also, lights were necessary. The maintenance department was notified and the tractor was shutdown to install new lights. This same experience and procedure occurred on three consecutive days. On the fourth day, after applying these two basic functions, heavy guards were installed over the headlights eliminating the problem. By eliminating this repetition on the fourth day, which should have been eliminated no later than the first day, and preferably prior to the clearing job, the cost of the lights, maintenance labor and down-time were finally eliminated.

This is a simple problem and illustration. Such corrective measures, even of a more important nature, are performed by many maintenance departments all over the world, which if known to the industry, including manufacturers, distributors and customers, would be of mutual benefit toward increasing availability.

Manufacturers should be encouraged to offer more service engineering, direct to the customer, replacing if necessary, some of the present sales engineering. Through service engineering, customer corrective measures could be quickly evaluated. Assistance would be available for analyzing failures and developing corrective measures in the shortest time. Through this direct contact, the manufacturer could, at an accelerated rate, incorporate such corrective measures in the products as an aid to increasing availability.

A good corrective maintenance program should strive to increase rebuilding work to increase availability. This can be realized, to an extent, by assigning the proper number of adequately trained maintenance personnel to disassemble the unit, inspecting the component parts for replacement needs, assuring an even and timely flow of necessary replacement parts and utilizing the same personnel for assembly. This can be accomplished through training, experience, good management, and an alert and aggressive distributor.

At least one of the maintenance personnel responsible for the corrective maintenance and performance should accompany the unit during its first few hours of resumed operation. This procedure can very often be an aid to increased availability, in that any failures or necessary adjustment can be performed immediately. The individual can observe, first hand, the results of his efforts, being assured any initial failures are his responsibility from which his reputation is established.

Any operating or preventive maintenance instructions or suggestions and any peculiarities can be passed on to the operating department personnel during this period, and prior to releasing it to them. It also tends to eliminate costly confusion originating from so-called "buck passing" between departments and personnel.

GRATE KILN PELLETIZING PROCESS AT HUMBOLDT

(continued from page 64)

is rated at 80,000 cfm at 7 in. SP and 400° F.

The No. 1 and No. 2 fans are identical but turn at different speeds. Maintenance is accomplished by welding beads of weld across each fan blade. Beads are laid down about one in. apart and at short intervals to help reduce heat build-up and consequent blade warping.

Figure 2 shows the components of the system, their relative size and the gas flows are indicated by arrows.

Ambient air is blown into the cooler by a 100 hp fan and is heated to about 1700° F while passing through the bed of pellets discharged from the kiln. The kiln is operated at 2450–2470° F (bed temperature). The preheat zone is kept at 2000° F by means of a small (10 gpm) oil burner. The average windbox temperature of the gases is in the range of 600–650° F. The gases into the No. 1 fan are in this same temperature range. About 30° F is lost in getting to the drying furnace where the temperature is in the range of 500–600° F. The gases in the drying windbox (common to drying section) are in the range of 180°–220° F.

High Quality Pellet Produced

The pellet quality since the plant started has been exceptionally high. A standard ASTM tumble test shows only 4.0 to 4.5 percent passing 28 mesh after tumbling for 200 revolutions. The product discharging from the cooler averages 99.2 percent plus 20 mesh, without being screened. There is no screening of the product prior to shipment. The average crushing strength of ½ in. pellets is in excess of 750 lb. A ⅜ in. pellet crushes at over 500 lb.

A typical screen anlysis from either stockpile or pocket shipments would be:

+ ½"	70%
+ ⅜"	97%
+ 3M	98.5%
+ 20M	99.2%

A typical chemical analysis is:

% Fe	62.20
% SiO_2	9.00
% S	0.005
% Phos	0.062
% Moisture	0.3

Bentonite is delivered in covered railroad hopper cars and is unloaded pneumatically. The bentonite is purchased pulverized with at least 90 percent passing 200 mesh.

No. 6 fuel oil is delivered in railroad tank cars and is steam heated for pumping. A storage tank of 420,000 gal capacity allows a month's supply to be kept on hand. The oil contains about 149,000 btu per gal with a maximum of 3 percent sulphur. Daily oil consumption varies between 14,000–15,000 gal.

Electricity is brought into the plant at 2300 volts, through two 1000-kva transformers and distributed into two control centers. All d-c power is generated at 230 volts. Except for two motor generator sets (kilns) the direct current is all generated in static equipment (rectifiers).

In summary, the start-up, operation and maintenance of the Humboldt pellet plant has been very favorable.

The process of regrinding prior to pelletizing is of paramount importance to the pellet operation. The regrind operation must be closely controlled to avoid wide deviations in either grind or moisture. Uncontrolled filter cake from the regrind section will void all pelletizing efforts.

Mine Haulage With High-Frequency Electric Locomotives

Translated expressly for Mining Congress Journal from UGOL' (Coal) No. 6, 1960, pp. 29-33, by Royer and Roger, Inc., Washington, D. C.

The Russians have developed an electric mine locomotive (not a battery locomotive) that eliminates the trolley pole

THE Donets Scientific Research Coal Mining Institute (DonUGI), the Moscow Institute for Power Engineering, and the Donets Coal Mining Machinery Institute (Dongiprouglemash) have developed and tested a new contactless, high-frequency electric mine locomotive.

Power is transmitted from a supply network to the moving locomotives by induction (Figure 1). A high-frequency generator (2500 to 3500 cycles) feeds two insulated cables suspended in the haulage way. The current in the cables, automatically maintained at a constant level, induces an alternating electromotive force of identical frequency in the receiving circuit (power receiver) of the electric locomotive. Semiconductor rectifiers rectify the high-frequency current and feed it to common traction motors with series excitation.

Rotating motors are used at the present time as high-frequency generators; however, ionic frequency converters can be used as well.

The power line and the windings of the power receiver are made of cables with an insulated core. Thin copper wire is wound around these cables to reduce skin effect. Power line and power receiver circuits include condensers to compensate for inductance.

A current, determined by the line losses, passes through the generator windings when there is no useful load on the line. The current in the generator increases with the increase in energy used by the electric locomotives.

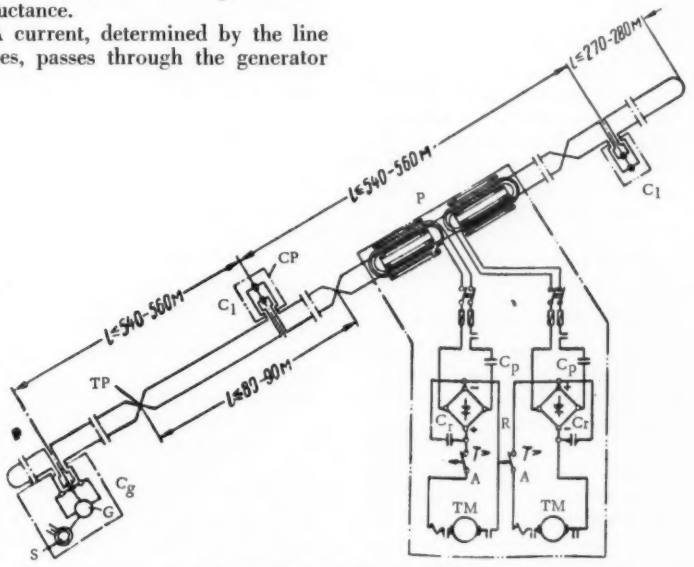


Fig. 1. Circuit Diagram for Haulage Operations with High-Frequency Electric Locomotives

TM—Traction Motor; R—Semiconductor Rectifier; C_r—Rectifier Condenser; C_p—Condenser Battery of Power Circuit; A—Maximum Current Machine; P—Power Receiver; C_1—Line Condenser Battery; C_g—Generator Condenser Battery; G—High-Frequency Generator; S—Servo-motor; CP—Compensation Point; TP—Transposition Point

The power receiver, which is situated on top of the electric locomotive, consists of a steel core and several cable turns. To prevent inadmissible voltage increases, the power receiver winding is divided into separate sections, each consisting of several cable turns in series with a condenser.

The work of the traction motors in a high-frequency locomotive is determined by the voltage changes at the terminals. In the case of low loads this voltage is close to that of no-load conditions in the rectifier, while in case of high loads this voltage is reduced as a result of the voltage drop in the receiving circuit of the electric locomotive and in the rectifier. The voltage drop in the receiving circuit depends upon the losses in the windings and core of the power receiver, the condensers, the metallic parts of the locomotive, and the metal props of the mine. The traction motors of the locomotive operate at maximum capacity when the receiving unit (inductance of the power receiver windings, capacitance of the circuit condensers, the rectifier with the motors connected, and the output condenser) is at resonance. The terminal voltage of the motors is reduced by taking the receiving circuit out of resonance when starting or regulating the speed of the electric locomotive. This may be accomplished by changing the capacitance of the condenser battery, or with the aid of a variable inductance choke. In the first instance, the cammed switch connects or disconnects the regulating condensers; in the second instance, the inductance of the circuit is changed by lifting or lowering the steel core of the magnetic circuit of the regulating choke changing the inductance of the circuit. All positions of the control box ensure efficient starting and speed regulation since the electric locomotive does not have starting rheostats.

Experimental Model Tested

An experimental model of a high-frequency electric locomotive (2500 cycles) was tested for the first time in 1951 on a narrow-gage surface track at DonUGI. In 1954, "Kontarnaya" mine No. 2 in the Donets Basin was equipped with contactless electric locomotives for haulage operations on a 1.5 km long test section. After seven months of successful operation all the equipment of the test section was in working order. The installation was dismantled and was transferred to the laboratory investigating possible improvement of the haulage operations. A new experimental section of the "Kontornaya" mine No. 2 (of the same length) has been operating successfully with two electric locomotives since January 1958.

The "Kontornaya" mine No. 2 is producing from the 1.45 meter thick seam 1_3, "Almaznaya". Gas liberation is high, the dust content, however, presents no danger. Planned production during the test period was 2230 metric tons of coal and 150 tons of rock per day. Both coal and rock are hoisted through an inclined shaft.

Eight-ton battery locomotives (type IIAR-1m and 8ARP-1) and 1.4-ton mine cars are used for horizontal haulage. The electric locomotives pull 25 to 30 mine cars at a time.

High-frequency electric locomotives were used for experimental haulage in drift No. 11, East. The haulage distance from the incline to the main shaft was 715 meters. According to schedule the daily load in the drift was 2110 tons of coal and rock (1470 mine cars or 55 to 60 trains). On occasion the daily load reached 2350 tons (1630 mine cars or 60 to 65 trains).

Reinforced concrete props with wood or steel crossbeams were used in the drift. The total distance in the drift where high-frequency locomotives were employed and which was reinforced with steel crossbeams was 350 meters. The steel crossbeams are located 1.7 meters above the top of the rails. The height of the drift ranged from 2.2 to 2.3 meters. The ground had a high moisture content. The average grade (in favor of the loads) was 0.6 percent; the maximum grade (within one train length) was 0.105 percent.

In two years of operation the electric locomotives have transported over 35,000 train loads.

The test installation consists of two electric locomotives, a high-frequency haulage substation, and a traction line.

The experimental models of the high-frequency eight-ton electric locomotives are similar in design to the 8 ARP1–600 battery locomotive. The mechanical parts of the high-frequency electric locomotives, the traction motors, and the headlights are the same as in the 8 ARP1–600 electric locomotive.

The following equipment is installed on the high-frequency locomotive for the reception and conversion of the high-frequency current:

A flat power receiver with a core of transformer steel. The winding of the receiver consists of 13 turns of cable, 105 sq mm in cross section. The power receiver rests on asbestos-cement slabs and is covered with a vinyl plastic lid. It consists of two sections enabling the locomotive to pass under points where traction lines intersect. This is necessary to reduce harmful e.m.f. induced in mine communication cables, rails, etc.

Twelve polystyrene condensers designed for a current frequency of 2500 cycles, a capacitance of $35 + 2$ microfarad, an hourly load voltage of 440 v, and an hourly power rating of 107 kvar.

Two selenium rectifiers are assembled into a single-phase bridge circuit. Each rectifier has 264 elements 100 by 100 mm in size with a permissible reverse voltage of 40 v. The elements of each rectifier are placed in two casings and covered with crystalline quartz sand. Experimental germanium and silicon rectifiers have recently been installed on the electric locomotives. The rectifiers are connected in series; the traction motors in parallel.

The condensers and the rectifiers are placed in an iron box and covered with a shield of two mm thick copper sheet.

One of the electric locomotives has a special control box for regulating the traction motors. The upper part of the control box has a GR-5A type controller in which four contacts have been left over. The circuit has been modified to suit the needs of the high-frequency electric locomotive. The bottom part of the controller has a variable inductance choke which starts and regulates the speed. The movable part of the core of the choke is mechanically connected to the main shaft of the controller.

The inductive resistance of the choke decreases smoothly when the handle of the main controller shaft is turned.

The second electric locomotive is regulated by a controller equipped with cam contactors. It was converted from a MT-1B type controller and made to suit the needs of the high-frequency electric locomotive circuit. Starting and speed are controlled by gradually cutting the capacitance of the regulating condensers when turning the handle of the main controller shaft, i.e. by balancing the oscillatory circuits of the electric locomotive.

In either case, there is no starting resistance.

The electric locomotive is illuminated by the high-frequency current of 2500 cycles, rectified by two small selenium rectifiers connected in paral-

lel. Each of the rectifiers is fed by one of the two power receiver sections through a transformer and a choke.

The dimensions of the experimental high-frequency electric locomotive are as follows: length 4690 mm, width of frame 1000 mm, width of power receiver 750 mm, height of power receiver from the top of the rails 1680 mm.

The traction substation consists of two frequency converters composed of three-phase asynchronous short-circuited moters and 2500-cycle single phase generators with a capacity of 100 and 60 kw. The converters are manufactured as a single shielded unit.

The transformer feeding the traction substation and the oil switch, together with the converter, are placed in one chamber. The control device is located in the locomotive shop.

The traction line is made of high-frequency, 500-v cable having a cross-section of 108 sq mm and an outer diameter of 37 mm. Power cables are suspended along the drift on flexible hangers spaced 2.5 to 3 m apart.

The overall length of the electrified single-track line is 1.6 km. Cable inductance is compensated by polystyrene condensers placed in three different spots: in the shop and at two special compensation points.

On a single track line the cables are transposed every 65 to 70 meters; on double track lines the cables are transposed every 100 to 110 meters.

Line current is maintained at 200 amp by a dynamo-electric amplifier feeding the excitation winding of the generator.

The experimental haulage installation with high-frequency electric locomotives was tested in 1958 after it had been in use for six months. The efficiency and reliability of the entire haulage system was tested; the traction characteristics of the locomotives and their working properties were checked; and operating safety measures were determined.

During the tests the electric locomotive developed a draw-bar pull of up to 1600 kg. The characteristic performance curve of the selenium rectifiers of the locomotive shows that its maximum capacity at the terminals of the traction motors is 12 kw. If germanium or silicon rectifiers are installed, maximum capacity increases to 15 to 16 kw. A locomotive with a train of 25 empty mine cars attains a speed of 11.5 km/hour.

Sparkless high-power transmission to moving electric locomotives represents a considerable progress in assuring the safety of mine haulage operations with electric locomotives. The high-frequency electromagnetic field forming around the cables of lines is capable of transmitting electric energy not only to locomotives but to any conductor located in the field. An analogous effect is produced by the field of the power receiver of the electric locomotive. Spark safety of rails, pipes, high- and low-power cables running along the traction line, is attained because of the relatively small distance between the traction line cables (400 mm) in relation to the distance between the points where the cables are transposed.

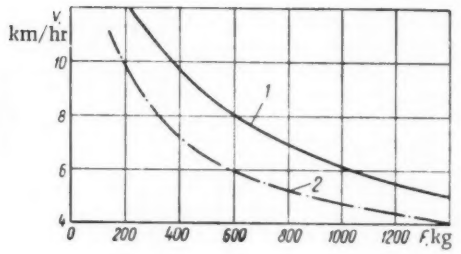


Fig. 2. Traction characteristics of electric mine locomotives in operation. 1—high-frequency electric locomotive ($h_1 + 50$ mm) 2—battery locomotive

The horizontal distance from an extraneous cable or pipe line to the nearest line cable must be not less than 0.6 m. The electromotive force induced by the current of the traction line in extraneous conductors is of the order of 30 v.

Safety of Operation Has Been Proven

The investigations undertaken by the All-Union Scientific Research Institute of Work Safety show that voltages of 30 v and a frequency of 2500 cycles are of small danger to human life. Line cables in which the voltage goes up to 1500 v are made safe through reliable insulation. There is no reason to fear that the electromagnetic field involved in haulage operations with contactless electric locomotives, which do not exceed sound frequencies, will harm mine personnel. If the telephone lines in the mine are in normal condition, i.e., if the specifications relative to the permissible asymmetry of cables with respect to insulation resistance and capacitance are observed, interference arising in the telephone network from the traction line will not be excessive. An effective way to eliminate this interference is to use shielded telephone cables with a grounded shield. Experience shows that traction lines do not cause great heating of metallic objects, even if they are brought up against the cables. Tests and long-term use have also shown that it is perfectly safe to transport electric detonators in mines where high-frequency electric locomotives are operating.

More than two years have elapsed from the time of the first operations with high-frequency electric locomotives. During this period the advantages of this new form of mine haulage over battery locomotives have become evident.

High-frequency electric locomotives are at present the only permissible mine locomotives which can be manufactured and the entire haulage operation with these locomotives satisfies the safety requirements for gaseous and dusty coal mines. The permissible characteristics do not reduce the traction characteristics of these locomotives.

The performance of high-frequency electric locomotives considerably exceeds that of battery locomotives under equal conditions. The capacity of contactless high-frequency electric locomotives does not depend upon its working time. With a daily load volume of 1200 tons or more, the specific power consumption is lower with high-frequency electric locomotives than with battery locomotives.

The need for expensive storage batteries and the corresponding charging equipment is eliminated. Gases and electrolytes which are harmful to the attending personnel are also eliminated. High-frequency electric locomotives do not require monthly checks at the shop. There is no need for battery charging stations and the motor shops are of smaller size. Personnel engaged in the maintenance of batteries at the charging stations (washing, cleaning, repairs, etc.) is liberated for other work.

Under equivalent industrial conditions (length of haulage way, load volume, route profile), fewer high-frequency locomotives will be required for haulage operations than battery locomotives.

There are possibilities for a further improvement of haulage operations with high-frequency electric locomotives, and for increasing haulage efficiency as new types of materials and

electrical equipment are developed. These include: improved semi-conductor rectifiers; ferrite cores for power receivers; durable plastic materials for electric locomotives; ionic frequency converters, etc.

Research, experimental and construction work, as well as operation tests of high-frequency electric locomotives in mines, made it possible for Dongiprouglemash and the Moscow Institute of Power Engineering to develop a haulage system operating with contactless high-frequency electric locomotives which satisfy permissibility requirements while maintaining high efficiency (as compared to haulage with battery locomotives). An experimental group of haulage installations for three mines which includes 12 high-frequency, permissible electric locomotives (type ERV4) is at the present time being manufactured by domestic plants.

The locomotives and traction line equipment are permissible. The converter substations, equipped with 3000-cycle generators, are well ventilated with fresh air and are reliable.

The current will be rectified by domestic silicon rectifiers installed on the locomotives.

A characteristic feature of the mechanical part of the new electric locomotive is the long, low frame. The length of the locomotive from bumper to bumper is 5000 mm, hence it exceeds the length of 8ARP-1 type battery locomotives by 310 mm. The added length of the locomotive is needed for the installation of the power receiver.

Unlike the bumpers used at the present time, those of the new locomotive are equipped with a coupling device. The existing designs had to be abandoned because the locomotive with an attached mine car has to negotiate curves with a radius of 8 m.

The undercarriage with the traction motors and the frame suspension (without rings, springs and hydraulic shock absorbers) form the undercarriage cart—a single assembly unit.

The remaining mechanical equipment, as well as the assembled pneumatic and part of the electric equipment of the locomotive, are mounted on the frame.

The pneumatic equipment meets mine and permissibility requirements. It consists of pneumatic brakes, a pneumatic signal, pneumatic sander, a compressor and pneumatic apparatus.

Starting and speed control are by means of a 10-cam contact controller which changes the capacitance of the condensor battery.

Following are the technical characteristics of the new high-frequency electric locomotive of the type ERV-4:

Basic dimensions

Track width, mm	600 mm
Length from bumper to bumper	5,000 mm
Width of protruding parts	1,050 mm
Height from top of rails to top of power receiver cover	1,630 mm
Hard base	1,250 mm
Wheel diameter	610 mm
Minimum clearance between top of rails and locomotive frame	100 mm

Traction characteristics

Weight	8.5 tons
Number of driving axles	2
Transmission number of reducers	9.9

Hourly performance (line current 183 amp, distance between line cables 400 mm, clearance between cables and the winding of power receiver $h_1 = 50$ mm, metal supports):

rectified voltage	103	v
rectified current	220	amp
traction force	1,140	kg
speed	5.8	km/hr
capacity	18.0	kw

Lasting performance (same conditions as above)

rectified voltage	124	v
rectified current	96	amp
traction force	350	kg
speed	10.5	km/hr
capacity	10.0	kw

The operational advantages of electric locomotives (type ERV4) as compared to battery locomotives of the same weight are shown in Figure 2.

High-frequency electric locomotives are most economical when used for main haulage ways in gaseous and dusty mines with a high daily production.

"This certainly proves out the value of safety hats."

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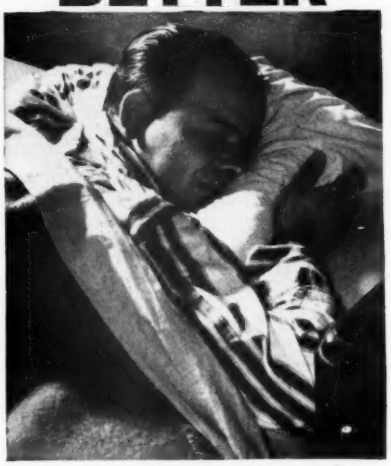

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AMERICAN CANCER SOCIETY

ROLE Of The PSYCHOLOGIST In MANAGEMENT

By ROBERT O. SHAFFER
Partner—Rohrer, Hibler & Replogle
Chicago

—Counseling to make a good management team better

PSYCHOLOGY has been making contributions to the industrial scene for the last half century. Particularly during the last twenty years, people have become more and more alert to the psychological aspects of their problems. Psychological testing is probably one of the better-known tools used in business today; it has been so popular that many have come to expect miracles of tests or have overused them as a substitute for their own judgment.

People in industry have drawn from the field of psychology to improve their interviewing, refine their procedures for selection and promotion of people, to plan and conduct training programs, morale studies, and market research. It is only recently that both psychologists and executives have been trying to apply psychological knowledge to the deeper and more elusive aspects of the management of people.

Getting Things Done Through Others

The essence of management is getting things accomplished through others. It is motivating, guiding, teaching; it is directing, developing, and rewarding human beings. The manager sets objectives and appraises progress toward them. The accomplishment of these objectives depends upon the abilities, the judgment, and the attitudes of both himself and his subordinates.

The manager's job is a complex one. The man who starts a business himself is close to the problems. He makes direct observations, and takes direct action on them. He hires a few hands to help him with the work, but by and large, he is making all the decisions. As the company grows, it becomes too broad for one man to handle. He needs more assistance and the problems require greater competence in more specialized areas than one man could possibly master. So, he hires men of specialized talents and shares his decision-making authority with them. His job changes to one of coordinating his people and using their observations and special knowledge to enrich his own judgment. He now spends more of his time in setting objectives and structuring his organization to accomplish them, in selecting the right men for key spots, and in creating an atmosphere where they can do their best work.

Mining, just as some other businesses, is getting more and more competitive—not only in terms of the inroads made by foreign reconstruction or the wider use of plastics, but also in terms of a limited supply of good mining managers. To stay ahead, companies must grow their own—make specialists into generalists.

Psychologist Has Specialized Knowledge of People

There have been tremendous developments in mining methods, in machinery and in data processing in the last 20 years and companies that want to keep competitive have been alert to make use of them. There have also been many developments in the study of human behavior. More and more is being learned about what makes people tick and how this knowledge can be applied to management problems.

Managers who want to keep competitive are learning how to use this knowledge to better understand, motivate, and develop their key men. This does not relate to gimmicks for the purpose of manipulating others since people resent being tricked. It means understanding people more fully and more accurately, getting a fix on their motivations, their objectives, their values, and appraising their intellec-

tual effectiveness, their emotional stability, their skill in human relations, and their insights. This takes professional training and experience. Just as the executive uses his legal counsel and his auditors and mining consultants as people from the outside who can bring their specialized knowledge to enrich his judgment, so he can use the talent of the professional psychologist in several areas of his work.

First, the manager uses his consultant to better understand some of his problems that have strong psychological overtones. An example might be the relationship between the home office and field management. People in the field might see the home office as a source of unrealistic policies developed by men who are schooled in law rather than in mining and they speak of measuring production in tons per lawyer hour. They feel that top-level decisions are not as prompt or practical as they should be. On the other hand, home office people might see field managers as impulsive and impatient mavericks, whose view of problems tend to be more provincial than company-wide, or as ambitious people who are trying to build their own little empire.

Now in an industry such as mining, where not many make the leap from the field to home office, this gap in understanding between home office and the field is likely to be more aggravated than usual. The key to better integration lies in the psychological factors—the attitudes, the prejudices, the kind of communication between the two, the willingness of each group to learn and understand the problems of the other, and the courage to face facts, even when it means having to change traditional positions.

Creating Understanding Between Line and Staff

Another example of special problems is the area of line-staff relationships. Here we have the old "tug-of-war" between the line man who carries the responsibility for decision and results and the staff specialist whose only authority is the authority of ideas—yet he is expected to see that poor practices are replaced with good ones. This is the problem of the mine superintendent who is responsible for costs and the safety engineer who wants to spend money to make his mine as safe as possible. How can these people with different interests and different responsibilities better understand each other and work together? This is the job of the executive, and this is where the insights of the psychologist can be helpful.

A second area where the executive makes use of a psychologist is as a coach in certain areas of his responsibility. He learns how to improve his ability to select his key men and he supplements his own knowledge with the psychologist's review of their personality characteristics. In other words, he finds out more about whether a candidate will do the job in addition to whether he can stimulate his people to their maximum effort and to the creativity which is such a priceless commodity in an organization. As the executive learns more about the process of emotional growth and development, he can more effectively help subordinates to utilize more of their latent potential.

Articles in this publication tend to deal with quantitative data—production figures, percentages, ratios. They are tangibles—the language of the business. The characteristics of people, however, cannot be understood in terms of ratios and percentages. The manager needs to learn a new language and perspective to comprehend the intangibles of a human personality.

Pyschologist Used as Sounding Board

The executive uses the psychologist to help him think through his organization planning, with particular respect to that most important factor and the one he knows least about—the key people. With so much merging going on these days, sound organization planning is essential if two groups of key men are to be meshed successfully. The executive also uses the psychologist as a sounding board as he thinks through plans and problems that he cannot discuss with anyone else because of their implications for others in the company. Such problems as the president's relationship to his board or his plans for his successor are things which he usually cannot discuss with insiders.

The manager uses his psychologist in still another way—as a personal resource in understanding himself better. As he strives to do clearer thinking and make sounder decisions, the psychologist can help him to better understand the fundamental bases of his behavior, the biases which sabotage his judgment. and the factors which help and hinder him in delegating to others and in communicating with others. The executive, with such help, can develop better understanding of the bases of his tensions and what he can do about them. We live in the midst of change, both as growing people as well as the changes in our business and cultural environment. The executive who understands more of his reactions to change can more effectively live with it and keep pace with it.

Finally, an executive who uses his psychologist to help him to understand himself, learns how to comprehend and resolve the conflicts which come with moving from the direct, tangible work in the field to running a business from behind a desk. There is less action and physical activity—more legal work, policy problems and intangibles to deal with. He must rely on reports and observations of others rather than on his own first-hand size-up of problems. He is concerned that his old friends will regard him as a paper shuffler or one of those home office so-and-so's that both he and they had criticized so often. In short, the psychologist helps the executive to better understand the loneliness of his command position and to make those decisions—often unpopular—which only he can make.

Aim is to Make People More Effective

In closing, it is worth mentioning what a psychological consultant is not. He does not bring molds to a company and try to fit people into them. He is not a spy or a hatchet man for the boss. His objective is to help people to become as effective as possible. He is not a doctor for psychotic or sick people, although he does run into these occasionally. His aim is to make good men even better. He does not betray confidences or take advantage of his special information.

The psychologist does not make operating decisions, or tell management how to run its business. He is not a substitute for the manager's judgment—he enriches judment. He is not an expert on mining—he is an expert on people. He does not tell the executive what to do; he helps find out what is best to do. He does not perform miracles—he helps management to better understand and handle management problems. His goal is to help make a good management team better. He is a dedicated and ethical professional person, a specialist who can be used to supplement knowledge and experience, a discreet confidante, a critical sounding board for ideas, a teacher, and an understanding friend.

As Viewed by HENRY I. DWORSHAK of the American Mining Congress

WHEN the second session of the 87th Congress convenes January 10, a priority item on the agenda of the House will be election of a Speaker to succeed Sam Rayburn of Texas, who died last month after serving for over 17 years as Speaker —more than twice as long as any other man in history. He had been a member of Congress for nearly 49 years.

Rep. John W. McCormack (Dem., Mass.). who has served for 17 years as Majority Leader, is expected to be chosen to succeed "Mr. Sam."

On the other side of the Capitol, Senate Republicans will meet to elect a new chairman of their policy committee to succeed Styles Bridges of New Hampshire, who also died last month. Serving his fifth six-year term in the Senate, Bridges was senior Republican Senator.

★ ★ ★ ★ ★ ★

Washington Highlights

CONGRESS: McCormack may be new House Speaker
FOREIGN TRADE: President to submit broad program
RESIDUAL OIL: Tighter quotas seen as necessary
SILVER: Treasury stops sales to industry
URANIUM: Procurement studies urged at hearing
COPPER: Mansfield pushes cartel proposal
LEAD-ZINC: Kelly conducts western conferences

★ ★ ★ ★ ★ ★

PRESIDENT'S TRADE PROGRAM READIED FOR CONGRESS

President Kennedy has announced that he will present a new foreign trade program to Congress in January—thus setting the stage for what will probably be the most bitter Congressional battle in the history of the 27-year-old Trade Agreements Act, latest extension of which will expire next June 30.

While the President did not give details of his program, recent speeches by members of his Cabinet indicate that he will ask for sweeping authority to make across-the-board tariff reductions, particularly for the Common Market countries of western Europe. Presidential authority under the present Trade Agreements Act is limited to item-by-item rate reductions, with a maximum reduction of 20 percent over a four-year period.

Commerce Secretary Hodges had said earlier that the Administration needs broad powers to negotiate trade barrier reductions in order to compete with the "galloping economies" of Europe and Japan. The United States "cannot counter the power of the Common Market through a return to protectionism," he stated.

At the current Geneva, Switzerland, conference of the nations which are members of the General Agreement on Tariffs and Trade (GATT), Under Secretary of State Ball pledged the United States to a policy of across-the-board reductions. But, he added, the new program faces difficulties in winning Congressional approval.

Meanwhile, a Congressional subcommittee on foreign economic policy released a report in which the Government is urged to assist industries hurt by import competition through direct aid to individual companies. The report suggested also that workers and communities adversely affected be given help through the Area Redevelopment program and retraining assistance.

TIGHTER QUOTAS ON IMPORTS OF RESIDUAL OIL SOUGHT

Present quotas on imports of residual fuel oil must be tightened, rather than eliminated, to prevent the deterioration of the coal industry's production base and its capacity to expand production in an emergency, an industry spokesman warned a House subcommittee which is studying the oil import control program.

C. J. Potter, president of the Rochester & Pittsburgh Coal Co., testfied that the industry cannot maintain an adequate production base "in face of continued loss of markets to foreign fuel and certainly an end to import controls would greatly accelerate the pace of market losses."

He pointed out that the coal industry has done "a truly remarkable job in doubling its productivity within a few years, thus enabling the price at the mine to remain stable." But it does not matter, he stated, "how good a job the coal industry and the railroads do on the price front if this imported oil is always present and available for sale at prices which are manipulated to undersell coal."

Potter said he was confident that the subcommittee's study would show the "necessity of maintaining reasonable and sensible limits on the imports of residual oil."

PRESIDENT HALTS SALE OF TREASURY SILVER

Late last month President Kennedy ordered the Treasury to discontinue sales of silver to industry. At the same time, he announced that he would ask Congress to repeal (1) the Silver Purchase Acts, under which the Treasury is required to accept any domestically mined silver offered to it at 90.5 cents an ounce, and (2) the silver transactions tax.

In a letter to Treasury Secretary

Dillon, who had recommended the actions, the President stated that the three steps "will permit the establishment of a broad market for trading in silver on a current and forward basis comparable to the markets in which other commodities are traded."

Prior to the stop-order, Treasury stocks of free, or nonmonetized, silver had fallen to less than six months' requirements for coinage. Sales to industry had been heavy, while virtually no newly mined silver had been tendered to the Treasury since early in 1959.

To meet coinage needs, the Treasury will call in its outstanding $5 and $10 silver certificates, thus providing sufficient monetary silver for subsidiary coins for several years.

The President also said he would ask Congress to authorize the issuance of $1 and $2 Federal Reserve notes for the gradual replacement of silver certificates of these denominations. The move would make further silver available for coinage requirements in the future.

According to the President, the over-all effect will be "the eventual demonetization of silver except for its use in subsidiary coinage."

Senator Robertson (Dem., Va.), chairman of the Senate Banking and Currency Committee, stated that the President's legislative recommendations would be given "prompt consideration."

URANIUM PRODUCERS ASK AEC TO INITIATE STUDIES

Uranium industry spokesmen have again urged the Joint Atomic Energy Committee and the Atomic Energy Commission to undertake immediate studies as a basis for establishing the Government's policy regarding uranium purchases after 1966, when the current procurement program expires, and to determine whether domestic reserves of uranium are sufficient to meet long-range military and civilian requirements.

The producers' views were expressed at a hearing in Moab, Utah, conducted by the Joint Committee's Raw Materials Subcommittee under the chairmanship of Rep. Aspinall (Dem., Colo.).

Richard S. Newlin, vice president, The Anaconda Co., stated that doubt has been expressed as to the validity of AEC estimates that ore reserves at the end of 1966 will total 40 million to 50 million tons. He suggested that consideration be given to encouraging the resumption of exploration—now virtually at a standstill—to assure adequate uranium reserves, "considering the vast sums that have been, and will continue to be, spent on the development of power reactors and our ultimate dependence on reactor power."

Miles P. Romney, manager, Utah Mining Association, said the uranium mining industry can only deteriorate unless some reasonable program is drafted to help guide the way through the uncertain period looming in the post-1966 period.

Eugene B. Hotchkiss, executive vice president, Vitro Minerals Corp., suggested that the AEC permit the "substitution of economically mineable ores, regardless of when developed, or the transfer of other allocations up to the amount of otherwise unfulfillable quotas established under the present AEC rulings." Otherwise, he indicated, total projected domestic deliveries of uranium oxide may fall short by 5,000 to 10,000 tons.

MANSFIELD WILL REVIVE COPPER CARTEL PROPOSAL

Senator Mansfield (Dem., Mont.), majority leader in the Senate, has announced that he will revive a proposal he made early this year for an international copper agreement to help stabilize production and prices.

He plans to get "a firm commitment one way or another" from the Administration on his plan, which the Departments of Interior, Justice and Commerce have been studying for months.

The copper industry has been operating for decades on a feast-or-famine basis, he said, but a Federal subsidy such as the one approved for the depressed lead-zinc industry this year would be of no benefit. He added that he is opposed in principle to cartels, but that in the case of copper "it's the only way I can think of to create a steady price structure, steady employment, and steady production on a year-round basis."

INTERIOR DEPARTMENT HOLDS LEAD-ZINC MEETINGS

Assistant Secretary John M. Kelly and other Interior Department officials have completed informal conferences with mine operators and local government officials in four lead-zinc mining areas, with the recently enacted small-mine subsidy law a major topic of discussion. The conferences were held at Miami, Okla., Albuquerque, N.M., Denver, Colo., and Spokane, Wash.

The subsidy law authorizes the Secretary of the Interior to make stabilization payments to eligible domestic producers of lead and zinc. Before payments can be made, however, funds will have to be appropriated by Congress.

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personals

William Bellano, formerly excutive vice president of operations, has been named president of Glen Alden Coal Co. He succeeds **Harry W. Bradbury,** who recently resigned as president but is continuing

W. Bellano

H. W. Bradbury

with the company's parent organization, Glen Alden Corp., as a consultant. Bellano has been with Glen Alden for about one year, having previously been president and chief executive officer of Gulf Sulphur Co. He also served as vice president of engineering for International Minerals & Chemical Corp. In addition to becoming president of Glen Alden Coal, he was named a director of Glen Alden Corp.

Cris Dobbins, president of Ideal Cement Co., has been elected chairman of the board of Potash Company of America.

Philip R. Bradley was recently elected president of the newly-formed California Mine Operators Association at its first meeting in San Francisco. The association was created to promote the welfare of the mining industry on a State-wide basis with 20 major mining companies participating in its formation. Other officers besides Bradley include **Arthur G. Moore** of Gladding, McBean & Co., who was named vice president, **Richard S. Funk,** Great Lakes Carbon Corp., who became secretary-treasurer, and **Edward Arthur,** formerly manager of the Mining Division, Los Angeles Chamber of Commerce, who was named managing director. Headquarters of the organization will be in Sacrmento.

P. R. Bradley

Thomas B. Nolan, director of the U. S. Geological Survey, was one of five career Government officials recently named to receive the 1961 Rockefeller Public Service Awards for distinguished service to the nation. Recipients of the award were selected by Princeton University's School of Public and International Affairs. Each individual will receive a $5000 grant plus an opportunity to draw additional funds for projects designed to strengthen the Federal service. Nolan holds a bachelor of philosophy degree in metallurgy from Yale University where he also obtained a doctorate degree in geology in 1924. He then joined the USGS as a geologist, becoming assistant director in 1944. He has been director of the Survey for the past five years.

Leonard C. Rose was recently elected to succeed **Alwin F. Franz** as president of Colorado Fuel & Iron Corp. Franz, who has served as president for the past nine years, has been named chairman of the board. **Charles Allen, Jr.,** chairman since 1945, will continue with the company as chairman of the executive committee. Rose was formerly executive vice president, having been elected to that post in April following service as director of purchases. He has been with the company since 1929.

Roy E. Nelson will succeed **E. F. Goodner** as president of American Gilsonite Co. on January 1, 1962. Goodner, who has been president of the company since 1949, is joining the Ortho Division of California Chemical Co. as its president. Nelson has been with American Gilsonite for 12 years and has been vice president since 1957.

James N. Sherwin was recently elected vice president of Consolidation Coal Co. He has been vice president and a director of The M. A. Hanna Co., from which positions he recently resigned. He started with Hanna in 1933 and during his association with the company occupied various positions in the sales and lake departments and ultimately became vice president.

Raymond H. Feierabend has been elected a vice president of Freeport Sulphur Co. He will be responsible for the company's sulphur operations in Lousiana, which include five mines currently producing at a rate in excess of 2,000,000 tons a year.

Feierabend joined Freeport in 1942 and served as superintendent of the company's largest mine, Grande Ecaille, La., from 1953 to 1956. In 1957 he was named assistant vice president and placed in charge of the development of Grand Isle, the world's first offshore sulphur project, located seven miles out in the Gulf of Mexico.

Woods G. Talman, assistant vice president-operations-coal, U. S. Steel Corp., has been elected chairman of the Coal Mining Section, National Safety Council. Long active in mine safety work, Talman is Chairman of the Committee on Mine Safety of the American Mining Congress.

W. Owen Lawrence has been appointed vice president of manufacturing, Universal Atlas Cement Division, U. S. Steel Corp. He has been with Universal Atlas since 1933 and from 1955 to 1960 was vice president of operations. For the past year and one-half he has been directing the division's research activities in purchasing, raw materials, and manufacturing.

Joseph M. Richards has become vice president of operations for Blue Diamond Coal Co. He was formerly general manager of mines.

Martin L. Frank has been elected vice president of Standard Beryllium Corp. Formerly secretary-treasurer, he will be succeeded in that post by **Paul M. Kaufman.**

Layton DeLauter, DeLauter Coal Co., has been elected president of the Ohio Reclamation Association. **R. C. Whitaker,** president, United States

Coal Co. was named to succeed DeLauter as vice president of the Association, which is engaged in the reclamation of strip mine lands in Ohio.

Harry P. Croft has been appointed vice president in charge of research and manufacturing, Copper Range Co. He was formerly vice president in charge of research.

Robert J. Hepburn, vice president, operations, United Electric Coal Companies, was recently elected president of the Illinois Mining Institute for 1962.

H. T. McBride has been named treasurer of Atlantic Cement Co., Inc. He was formerly with Bechtel Corp. which he served for 18 years, most recently as assistant secretary and manager of administration for the New York Office.

Max A. Robb has been appointed general superintendent of the operations of United States Fuel Co. at Hiawatha, Utah. He succeeds **T. C. Jackson,** who has joined Emerald Coal & Coke Co. as general superintendent.

Three personnel changes in the Utah Copper Division of Kennecott Copper Corp. have been announced. **T. J. Hunter,** superintendent of concentrator operations at the Magma mill, has been promoted to plant maintenance superintendent. Succeeding him is **Neil Plummer,** formerly superintendent at the Arthur mill. **Elmer C. Speers,** who had previously been a project engineer in the Western Mining Divisions, succeeds Plummer at Arthur. Hunter and Plummer have been with Kennecott since 1937 and Speers joined the company in 1940.

Lloyd E. Elkins, production research engineer, Pan American Petroleum Corp., has been elected president of the American Institute of Mining, Metallurgical, and Petroleum Engineers for 1962. He will take office February 20, succeeding **Ronald R. McNaughton,** manager of the Metallurgical Division of Consolidated Mining & Smelting Co., Trail, B. C. At the same time, it was announced that **Roger V. Pierce,** consulting engineer, Salt Lake City, has been named president elect of AIME to succeed Elkins in 1963.

Penn-Dixie Cement Corp. has announced three personnel appointments. **Charles S. Bennett,** who came to Penn-Dixie in 1951 as an engineer, has been promoted from plant superintendent at Kingsport, Tenn., to operating assistant at Nazareth, Pa. Succeeding him at Kingsport is **Joseph F. Gambill,** who started with Penn-Dixie as plant engineer in 1956. **Charles W. Grube,** with 15 years of cement industry experience, has joined Penn-Dixie as assistant chief engineer and will headquarter in Nazareth.

James W. Clemens has been named assistant superintendent of the Hiawatha mine of M. A. Hanna Co. With Hanna since 1952, he was formerly district production engineer and has been succeeded in that post by **Hermann Schubert.**

L. A. Hewitt, formerly regional geophysicist for American Smelting & Refining Co. at Salt Lake City, has joined Umont Mining Co., which is developing a lead, zinc, silver property in the Bayhorse district of Idaho.

Park A. Hodges, vice president, Behre Dolbear & Co., spent most of October in Europe, following which he went to Brazil.

OBITUARIES

Robert H. Jeffrey, 87, chairman of the executive committee and former president of Jeffrey Manufacturing Co., died in Columbus, Ohio, October 22. Mr. Jeffrey had been with the company since 1895, serving as president from 1922 to 1930, and as chairman of the board for the following 21 years.

Edmund B. Winning, 72, retired assistant vice president of Republic Steel Corp., died in Cleveland, Ohio, on November 5. From 1944 until retirement, Mr. Winning supervised all of Republic's mining operations. His association with Republic began in 1916 as an electrical and mechanical engineer for Republic Iron & Steel Co. in Pennsylvania. Earlier, he had worked for United Coal Co., Pittsburgh Coal Co. and Westinghouse Electric Corp.

James A. Hill, president of Illinois Zinc Co. from 1938 to 1952 died in Short Hills, N. J., November 12. He was president of Penn Southern Power Co. and Knickerbocker Fuel Co. before assuming the presidency of Illinois Zinc, predecessor company of Hydrometals, Inc.

Charles A. Charter, 72, founder and president of Charter, Inc., a mining and milling equipment firm in Ishpeming, Mich., and Hibbing, Minn., died September 8. Mr. Charter was vice president of sales for Lake Shore, Inc., before organizing his own company in 1951.

F. Cecil Baker, 72, retired president of American Potash & Chemical Co., died November 5 in South Shaftsbury, Vermont. Mr. Baker retired in 1945 from American Potash. He had been chairman of the advisory committee in the United States for Consolidated Goldfields of South Africa, president of Fresnillo Co., and a director of other mining companies.

Olaf Jalmer Anderson, 55, chief mechanical engineer, The Cleveland-Cliffs Iron Co., Ishpeming, Mich., died August 20 while swimming near Ishpeming. Mr. Anderson was well known on the Mesabi Range of Minnesota where he was employed by Butler Brothers and the M. A. Hanna Co. He later worked for Reserve Mining Co. and Conveyor Belt Service, joining Cleveland-Cliffs in 1954.

W. C. Browning, 75, former general manager of Golden Queen Mining Co. and mining consultant, died in Los Angeles, November 16. Mr. Browning had been in the mining industry since 1908 when he joined Silver King Consolidated Co. as an engineer. He went to Arizona in 1909 and over the next 15 years worked for Gunn-Thompson Co., Inspiration Copper Co., and Magma Copper Co., becoming general manager for Magma. In 1914 he became a consultant in California.

Wesley J. Moore, 52, branch manager of the Salt Lake City office of Ingersoll-Rand Co., died in Chicago on November 15. He had been associated with Ingersoll-Rand for 20 years in the western United States.

Thomas Kennedy, Jr., 46, chief counsel for Districts 1, 7, and 9 of the United Mine Workers of America and son of UMWA president Thomas Kennedy, died in Hazelton, Pa., October 30.

NEWS and views

Coal Pipeline to East Coast Planned

Texas Eastern Transmission Corp. and Consolidation Coal Co. are considering joint sponsorship of a 350-mile coal pipeline that would be used for moving coal from western Pennsylvania and West Virginia to East Coast electrical generating stations. The 350-mile pipeline would be 20 to 30 in. in diam.

By moving coal through pipelines, the two companies indicated they would be able to stabilize coal transportation costs. And they claim also that by eliminating the need for railroad sidings, barges, docks, coal towers, conveyors and other handling equipment, utilities that receive pipeline coal would save between five and seven percent of capital plant costs, which run to around $3,500,000 in a typical 500,000 kw generating station.

Texas Eastern and Consolidation Coal revealed detailed pipeline plans at a demonstration that showed two developments necessary to make direct pipeline transportation commercially feasible. One of these is transporting by pipeline a coal slurry containing 60 percent coal and only 40 percent water instead of the usual 50–50 mixture. The other is burning the coal and water mixture in a generator boiler furnace without first drying it.

The demonstration was at a South Amboy, N. J., generating plant of Jersey Central Power & Light Co., a subsidiary of General Public Utilities Corp. Slurry had been burned at the plant "under operation conditions" since mid-October in a Babcock & Wilcox Co. furnace that can burn undried slurry. The coal and water mixture, coming into the furnace through a spray nozzle, is spun about a cyclone of extremely hot air which vaporizes the water, igniting the coal particles which burn at over 3000°F within 1/100th of a second.

Because no coal pipeline exists in the East, the 3,000,000 gal of coal slurry being burned during a three-to-four-week experiment at South Amboy have been transported as 60–40 slurry through the only major coal pipeline in the world, running from Cadiz, Ohio, to Cleveland. The slurry went from there to New Jersey by oil barge.

Two principal drawbacks to the Cleveland pipeline deliveries have been the use of only a 50–50 coal and water mixture in the pipeline, and the need for filtering and drying the coal once it has arrived.

The demonstration at South Amboy showed that these disadvantages have been overcome.

Bauxite Imports Reach New High

Imports of bauxite rose to an all-time level during the third quarter of 1961, pulling total volume for the first nine months up to the level for the same period last year. On the other hand, the third quarter domestic production registered virtually no change from the previous two quarters and the 1961 total at the end of September was off more than 40 percent from the 1960 period.

Third quarter domestic production amounted to 316,000 long tons, dry equivalent, about the same as the output of 315,000 tons during the second quarter, according to data released by the Bureau of Mines.

Imports for consumption during the quarter amounted to 2,360,000 long tons, the largest that have been recorded.

Domestic mining combined with imports provided a total new supply of 7,369,000 tons for the nine-month period, still substantially under the new supply of 8,122,000 tons for the same period last year despite the 300,000 tons increase in the third quarter.

Of the total mined from domestic sources, 95 percent or 301,000 tons came from Arkansas mines and the remaining 15,000 tons from Alabama and Georgia deposits.

Imports from Jamaica, representing 57 percent of the total from outside sources were up 14 percent over the second quarter with a total of 1,343,000 tons. The remaining foreign tonnage comprised shipments of 716,000 tons from Surinam, 209,000 tons from the Dominican Republic, and about 40,000 tons each from Haiti and British Guiana.

Peabody Enters Alabama

Peabody Coal Co. has purchased the Waterside and Riverbank mines of DeBardeleben Coal Corp. Both mines are on the Warrier River near Birmingham, Ala., and coal can be barged directly to the Gulf of Mexico.

Peabody plans to increase the productive capacity of the Riverbank mine, which will require the temporary closing of this property until larger equipment can be acquired and installed. During this change-over period the production at the Waterside mine will be increased.

In commenting on the transaction, Newton H. DeBardeleben, president, stated that DeBardeleben Coal Corp. is retaining and continuing to operate all its other properties and facilities. These include its long established Empire and Sipsey operations in Walker County, Ala., which produce metallurgical and domestic coals, its retail coal division, and its entire coke and chemical operations at Holt in Tuscaloosa County.

Peabody, with headquarters in St. Louis, Mo., operates 23 mines in Ok-

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lahoma, Missouri, Illinois, Indiana, western Kentucky, and Ohio. In 1960 the company had a production of 28,670,000 tons of coal from its own mines and total coal sales of slightly more than 30,000,000 tons.

Low Grade Western Mesabi Ore to be Tested

A $65,000 technical assistance project to test low grade, nonmagnetic ores from the western Mesabi Range to determine their possible use for iron and steel production has been approved by the Area Redevelopment Administration, U. S. Department of Commerce.

The testing of the low grade ores will be conducted at the Fried Krupp Works in Essen, West Germany. The West German concern has developed the Krupp-Renn process, for producing iron and high concentrates from certain low grade ores, and is the only firm capable of making such tests.

Two different sets of tests will be conducted in West Germany—one involving anthracite fuels and the other involving lignite, a low grade bituminous fuel, extensive deposits of which are located in North Dakota.

Lamco Project Railroads Shipped

Two complete railroads have been sent on one ship to Liberia to speed development of a rich iron ore deposit located 165 miles inland. The vessel is transporting the largest shipment of railroad equipment on record—a dozen locomotives, 195 specialized railroad cars and hundreds of tons of rail and track to help construct the $200,000,000 Lamco project, an international joint venture of American and Swedish interests and the Liberian government.

Aside from the railroad, which is the major construction project under way in Liberia today, contractors are building complete pier facilities at Buchanan, dredging the harbor, and constructing some difficult roads in the Nimba Mountains. The new deepwater port of Buchanan will eventually handle ships to 65,000-ton capacity.

The Nimba range has been assayed as having 235,000,000 tons of proven quantities of high quality ore and 500,000,000 tons of reserves. First stage production is estimated at 6,000,000 tons of ore per year, most of which will be exported to Western Europe and the U. S.

Pollution of the Susquehanna River With Acid Mine Water Halted

The Pennsylvania Sanitary Water Board ordered three mine pumps stopped contending they were the cause of the death of thousands of fish in the Susquehanna River.

The State Mines Department later objected to the order, saying the move would soon cost 1080 workers their jobs.

The fish kill extends for about 55 miles from the Wilkes-Barre area south toward Sunbury. Bass seem to be the most affected. The order came after Merck & Co., a pharmaceutical drug manufacturing firm at Danville, Pa., 45 miles downstream from the mines, reported it might have to stop operations because of the high iron content of the river water. The plant employs about 1000 persons.

Installation of the pumps had been completed during October under a Federal-State mine drainage program. The mines affected by stoppage of the pumps are Huber, Sugar Notch, and No. 20 Tursdale, all operations of the Glen Alden Corp.

ALSO . . .

Tennessee Copper Co. has recently started work to expand facilities for production of the company's liquid sulphur dioxide. The work now in progress will result in a second unit which will double present capacity for liquid sulphur dioxide.

The Twenty-Third Annual Mining Symposium of the University of Minnesota and the annual meeting of the Minnesota Section of AIME will be held jointly, as usual, in Duluth from January 15–17, 1962. The three-day program is sponsored by the School of Mines and Metallurgy and the Center for Continuation Study of the University, in cooperation with the local section of the American Institute of Mining, Metallurgical & Petroleum Engineers.

Copper Range Co. has moved its corporate headquarters from Boston to New York City, according to an announcement by James Boyd, president of the company. Prior to this move Copper Range Co. had maintained its headquarters in Boston since it was established there more than 60 years ago.

Spencer Chemical Co. has announced that its subsidiary, Pittsburg & Midway Coal Mining Co., has purchased the Edna mine of the

Edna Coal Co. The coal strip mine is located in Routt County, near Steamboat Springs, Colo. Acquisition of the Edna mine is expected to more than triple Pittsburg & Midway's coal mining capacity in Colorado to a total of about 600,000 tons a year.

Freeport Sulphur Co. has announced that it will add a second production platform at Grand Isle, the world's first offshore sulphur mine.

The 1500-ft extension will bring the over-all length of the structure to 4076 ft. The project is located in 50 ft of water seven miles off the coast of Louisiana. Commercial operation began in June 1960, and the mining plant has proved to be highly efficient and fully capable of weathering offshore conditions.

North American Coal Corp. is laying plans to start construction early next year of a plant to produce aluminum oxide from aluminum sulphate.

The company currently is working on the design and engineering of a commercial scale decomposer for the plant.

The $1,000,000 plant will be built as an addition to the new 40,000-ton aluminum sulphate plant.

Aluminum sulphate will be produced from ore previously considered waste in coal mining operations. Some 10,000,000 tons of this ore presently are above ground on sites adjoining the new plant and many millions more are in the ground.

Bethlehem-Chile Iron Mines Co., a subsidiary of Bethlehem Steel Corp., announced it has submitted a plan for the consideration of Chilean authorities calling for the investment of approximately $9,000,000 in new facilities to increase production and improve the grade of ore from iron mines of El Tofo and Romeral.

The new investment contemplates concentrating plants for the treatment of ores, added equipment to facilitate increased production, and construction of additional housing for employes at the mines of Tofo and Romeral.

Republic Steel Corp. have resumed operations at its Lyon Mountain, N. Y., iron ore mine. Improved demand for Chateaugau pig iron produced at the company's Troy, N. Y., blast furnace, and the need to replenish pig iron stocks at the furnace made the mine reopening possible. With the resumption of normal mining operations at Lyon Mountain, approximately 200 employes will be recalled to their jobs.

A preliminary engineering study to examine the feasibility of a 1,000,000-ton-a-year iron ore mining property at Boston Township, near Kirkland Lake, Ont., has been ordered by Jones & Laughlin Steel Corp. The study will be conducted by Canadian Bechtel Ltd. The addition of a new blast furnace, now under construction at the company's Cleveland works, will increase iron ore requirements by 1963 and the Boston Township site is one of several possible sources for the additional requirements. The properties are owned by J & L and Cleveland–Cliffs Iron Co.

Bethlehem Mines Corp. have closed their Golden Ridge Mine 92 at Monterville, Randolph County, W. Va. Fire recently destroyed the head house and tipple.

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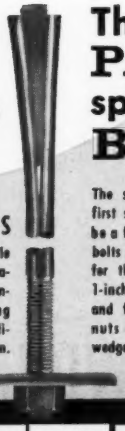

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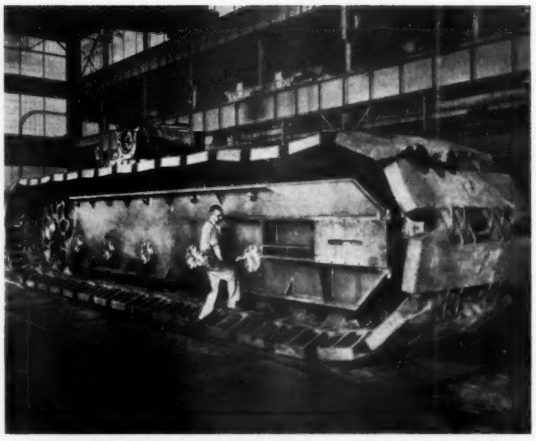

AN ERECTOR at the South Milwaukee, Wis. works of Bucyrus-Erie Co. is shown here putting the final touches on the first of eight crawler units for what will be the world's largest mobile land machine—stripping shovel to remove overburden from earth covering coal at a western Kentucky mine owned by Peabody Coal Co. The 400,000-lb crawler unit, nine ft high and 41½ ft long, with pads 7½ ft wide, is one of a set of two which will be side by side at each of the four corners of the excavator, 3700 lb apiece. The shovel, Bucyrus-Erie's Model 3850-B, will have a capacity of 115 cu yd. Peabody Coal Co. has ordered two of the shovels.

The 24th Annual Joint Solid Fuels Conference met in Birmingham, Ala., on October 5–7. The meeting was under the direction of J. A. Hagy, acting as committee chairman; and J. W. Nicol, chairman, southeast section AIME.

Joseph E. Moody, president of the National Coal Policy Conference, was principal speaker. The Percy Nichols Award was presented to Otto deLorenzi for "meritorious service in the development of color photography techniques used in the study of high temperature furnace operations."

The meeting was well attended with a registration of over 200 from all parts of the United States and Canada.

Republic Steel Corp. iron mines at Mineville, N. Y., closed for the last 15 months, have been reopened and are back in production. Fifty men returned to work to prepare for limited production. A total of 220 will be recalled later. When the mines were closed July 1, 1960, a total of 550 were laid off.

Tennessee Valley Authority announced coal purchases for electric power generation at their steam plants continued at a high level during fiscal year 1961. During the fiscal year, 18,500,000 tons of coal were received at the steam plants. The total cost delivered was more than $78,000,000.

Over the past six years TVA has been buying some 16 to 20,000,000 tons annually, about twice as much as any other electric power system in the United States. Fifteen years ago, when the region's power needs could be supplied almost entirely from hydroelectric plants at dams, TVA used less than 200,000 tons of coal. Since then the demand for electricity has grown so rapidly that hydrogeneration can now supply only about a fourth of total needs; the rest is generated at steam plants.

NEWS and views

Western

Silver Sales from Treasury Suspended

By executive order, President Kennedy on November 28 directed the Treasury Department to stop further sales of Government free silver immediately. The order also suspended the use of the remaining free silver in the Treasury for coinage purposes, stating that the amount so required should be obtained by retiring $5 and $10 silver certificates from circulation.

At the same time the President announced his intention to ask Congress to repeal the silver purchase laws requiring the Treasury Department to buy silver offered to it at 90½ cents per ounce. He also plans to ask for repeal of the present transfer tax on silver bullion. A fuller discussion of this development is included in the "Wheels of Government" column starting on page 75.

Vessels to Transport Alumina to Pacific Northwest

Reynolds Metal Co. is working on plans for converting two 16,500-ton oil tankers into 22,000-ton self-unloading bulk carriers that will carry alumina from the company's Corpus Christi, Texas, plant to its reduction works at Longview, Wash., and Troutdale, Ore. The ships would return to Galveston, Texas by way of Hawaii, where they would load raw sugar for shipment to the mainland.

Plans call for the acquisition of two 523-ft tankers that are to be converted to 626-ft vessels in an East Coast shipyard. Traveling gantry cranes with grab buckets will be installed for discharging the bulk cargoes. Estimated

(Continued on next page)

Program Chairman Named for San Francisco Convention and Exposition of American Mining Congress

Charles D. Michaelson, Vice-President, Mining, of Kennecott Copper Corp., has accepted the invitation of Raymond E. Salvati, AMC president, and Donald H. McLaughlin, chairman of AMC's Western Division, to serve as National Program Committee chairman for the 1962 Mining Show to be held in San Francisco, September 24–27. His acceptance marks the beginning of arrangements to develop a program that will attract mining men from around the world to learn of the American mining industry's latest accomplishments.

Michaelson, who until recently was general manager of Western Mining Divisions at Kennecott's Salt Lake City headquarters, is familiar to the industry as a man with broad operating and management experience—gained through nearly thirty years of mining activity with various mineral producing companies throughout this country and Latin America.

Recognizing the need for early program planning, to allow speakers additional time to carefully assemble data and prepare their presentations, Michaelson has scheduled the general meeting of the State and District Program Committee chairmen some two months earlier than similar meetings in the past. He will call on leading mining men from all producing areas of the country to assist him in gathering suggested topics and speakers for the Mining Show—with a view to lining up the most worthwhile material to fill four days of convention sessions next September. Our readers are invited and urged to submit suggestions of outstanding subjects and speakers by letter to the Program Committee. Won't you give this matter some thought and send your program ideas c/o American Mining Congress, 1102 Ring Building, Washington 6, D. C.?

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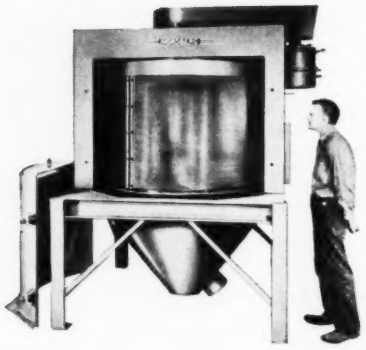

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(continued from previous page)

cost of the conversion has been placed at $3,500,000. The ships are to be placed in service late next year.

The tanker project will be the second shipping venture announced by Reynolds recently. In October, the company announced that it was obtaining three 7100-ton capacity barges for transporting bauxite between Caribbean ports and the United States. The barges are to be placed in service early next year.

AEC Signs Contract with Homestake-Sapin

The Atomic Energy Commission has contracted with Homestake-Sapin Partners for the purchase of 16,862,000 lb of uranium ore concentrates. The new contract covers the period from September 1, 1961 through December 31, 1966 and involves concentrates from the Partners mill and the Homestake-New Mexico Partners mill, both located at Grants, N. M. Assets of Homestake-New Mexico Partners were acquired by Homestake-Sapin Partners concurrent with signing of the contract, which replaces earlier agreements with the AEC providing for purchase of 13,062,000 lb of concentrates. The value of the new purchase contract is placed at about $135,000,000.

With signing of this agreement, there are but four uranium mills that have to sign with the AEC for the period extending into 1966. Still under negotiation are contracts with Gunnison Mining Co., Gunnison, Colo.; Mines Development, Inc., Edgemont, S. D.; Rare Metals Corp. of America, Tuba City, Ariz.; and Vitro Chemical Co., Salt Lake City.

Grouting Nears Completion

Grouting work being done in the Potash Company of America mine shaft near Saskatoon, Sask., is in its final stages. The company is sealing off the water-bearing Blairmore formation and aiming at the resumption of potash production from the mine as soon as it is feasible. The mine was closed in the fall of 1959 in order that water in-flow into the shaft could be brought under control. The company subsequently reached an agreement with Cementation Co. for grouting the entire shaft at an estimated cost of $900,000. Grouting has been completed in two lower zones of the shaft, and work in the top zone of the Blairmore is being continued. The company expects that clean-up work can be finished by or shortly following the first of the year.

ALSO . . .

Funds provided in connection with an exploration assistance contract involving the Office of Minerals Exploration and F. G. McFarland and S. R. Hullinger have been repaid. McFarland and Hullinger, partners in an exploration venture at the Ophir lead-zinc mine in Toole County, Utah, have completed repayment of $43,790.35 to the Government under a contract signed in 1955 with the Defense Minerals Exploration Administration. The exploration work was completed in 1957.

Under the exploration assistance program, the OME participates in the cost of exploration work. Government funds are repaid on a royalty basis from production during exploration, and if the Government certifies that production may be possible as a result of exploration, the royalty obligation continues until repaid or until expiration of the ten-year period usually specified in the contract. Royalty payments from 426 DMEA projects exceed $4,000,000 and 63 contracts have been completely repaid.

Laboratory produced beryllium oxide from the Topaz Mt. area of Utah has been successfully reduced to metallic beryllium at the Albany (Ore.) Metallurgy Research Center of the U. S. Bureau of Mines. Vitro Minerals Corp. produced the oxide from Topaz Mt. ore. The oxide was reduced to metal sponge and produced as arc melted buttons at Albany. Vitro in 1960 located an extensive deposit of beryllium mineralization in the vicinity of Topaz Mt.

A five-ton shipment of gold-bearing ore from the Red River area of Idaho has been made to the Helena, Mont., smelter of American Smelting & Refining Co. by Margaret Mining Co. The company believes the ore is the first to be shipped out of the area in 20 years.

A $65,000 exploration program has been launched by a newly-formed company, Montana-Coeur d'Alene Mines, Inc., at the Bay Chief lead-silver property in Sanders County, Mont. Present plans call for diamond drilling and 1000 ft of drifting. The objective of the work is to intersect the downward extension of a nine-ft wide vein of galena exposed on the surface by bulldozing. The vein is said to have an indicated strike length of 3000 ft.

An agreement that involves the production of high purity manganese dioxide has been reached between Century Mining Co. and Sterling Oil of Oklahoma, Inc. The companies have signed a five year contract under which Century is to supply 350,000 tons of manganese ores for processing at a plant that Sterling plans to erect in 1962. Century has a 1200-tpd heavy media plant and claims covering about 780 acres near Bouse, Ariz. Sterling proposes to produce a high purity manganese dioxide from Century ore concentrates and at this time is building a small prototype plant that employs a hydrometallurgical process. Reserves of manganese ore at the Bouse location are believed by Century officials to approximate 1,700,000 tons.

Duval Sulphur & Potash Co. is reported to be studying the feasibility of establishing a phosphate venture on Sublette Ridge near Border, Wyo. Duval and Kern County Land Co. during the last year have been evaluating phosphate reserves at the property, where mining was carried on during World War II for vanadium.

Production of mercury from the Red Devil mine near Sleetmute, Alaska, is expected to total about 5000 flasks for the current year. The Red Devil mine, located in the Kuskokwim River region, is one of the three largest mercury producing mines in the United States and is operated by Alaska Mines & Minerals Inc. The company is shipping a portion of its production to Japan.

A new month's production record has been established at the Nevada Mines Division concentrator of Kennecott Copper Corp. During 29 days of September, the concentrator handled 24,640-tpd of ore. The previous best record was set in June 1958 when 23,237-tpd went through the mill. Through the first nine months of the year the concentrator has averaged in excess of 21,000-tpd.

Standard Beryllium Corp. has acquired 84 percent of the issued and outstanding stock of Lajo Mines Limited, producers and concentrators of silver, with lead and zinc as by-products. Included are Lajo's mines, other properties and a mill, located near Kaslo, B. C. This is Standard's first major expansion involving a mineral other than beryl.

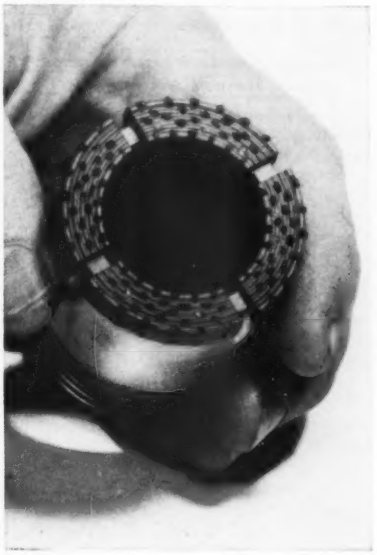
Dedication of the $500,000 College of Mines Building at the University of Idaho in Moscow took place November 3. The new building represents a cooperative effort between the mining industry and the State of Idaho, in which the industry matched a State appropriation of $250,000 toward erection of the structure. Ninety-seven companies and 300 individuals contributed to cost of construction.

Incorporation of Topaz Beryllium Co. was effected in November, arising from a previous option arrangement between a venture group headed by E. H. Snyder, president of Combined Metals Reduction Co., and the Anaconda Company. The new company is investigating beryllium ore reserves on a large beryllium deposit in the Spors Mountain section of the Spors-Topaz Mountain district, northwest of Delta, Utah.

The K. C. Li Medal and Prize for meritorious achievement in advancing the science of tungsten was recently awarded at Columbia University to three scientists of Union Carbide Nuclear Co. who headed research, engineering and production teams that collaborated to produce a pure tungsten compound from scheelite ore in the large Pine Creek, Calif., tungsten ore body. Glenford H. Clewett, Laurence E. Sousa, and Lewis P. Twichell received gold medals and $1000 prizes for their work in producing ammonium paratungstate on a commercial scale for the first time, at a new plant at Pine Creek. Previously scientists had been unable to commercially remove the chemically similar element, molybdenum, which is commonly associated with tungsten ores, and particularly with the ore in the Pine Creek deposit.

A new sand-fill system of mining has enabled Sunshine Mining Co. to mine narrow veins with less dilution from waste rock and a marked increase in grade, according to a recent interim report to stockholders. The Sunshine mine, in the Coeur d'Alene district of northern Idaho, started earlier this year to change over from a support method requiring heavy timber and periodic filling with broken waste rock to a cut and fill method utilizing mill tailings and occasional rock bolts, but very little timber. With the exception of a few stopes, in which only small isolated remnants of ore are being cleaned up, the new system has been applied to all stoping operations in the mine.

IT'S A FACT*



Longyear offers the fastest, easiest-to-use Diamond Bit Order Service in the world. New manual with Bit "Selector-Chart" makes your bit selection and ordering instantaneous. And you are assured of a superior bit for your job on every order . . . with no complicated design or cost calculations. Contact our nearest office for your free copy of the Longyear Diamond Bits Manual.

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P. O. Box 18, Poplar, Wis.

A deposit of disseminated chrysoberyl, which is believed to contain several million pounds of beryllium oxide, has been discovered in Clark County, Nevada, about 14 miles south of Mesquite. The find was made at Virgin mountain by Beryllium Associates, a Salt Lake City group that holds 41 unpatented mining claims in the area.

Book Review

***Arizona's Golden Road*, by Charles H. Dunning (Southwest Publishing Co., Inc. 185 pp. $3.85).**

The author, a veteran mining engineer, established himself as the ranking authority on the history of Arizona mines and mining in 1959 when, with Edward H. Peplow, Jr., he wrote *Rock to Riches*. In that book he set forth the prominent position of mining in the development of our nation and particularly of the Southwest, and described the basic nature of the mineral industry as a producer of new wealth—writing in a nontechnical manner with a view to giving the general public a better understanding of the risks involved in seeking out and developing our mineral resources, and their contribution to our national welfare.

Once again "Chuck" Dunning has drawn upon more than a half-century of first-hand experiences in writing this nostalgic collection of stories about prospectors and miners. The sketches—17 in all—cover a broad field ranging from robust humor to pathos, and all are packed with human interest. They have the touch of authenticity that could stem only from the author's long and close association with mining activities in the Southwest.

In this book you will meet the guitar-playing goldbrick, Jose Jerres, whose wandering burros led him to a gold discovery . . . learn how the Spanish Fire Eaters, who could mine in a sulfurous atmosphere, finally became extinct in Arizona . . . join old prospector Ed and his burro Millie as their lives approach their end in "Atop the Harquahalas," an ending which undoubtedly was the fate of many others who roved the mountains and deserts in search of elusive mineral wealth.

Several of these yarns—"Carnation and the 'H' Flag," "The Nights Were Long, Confucius Say," "The English Speaking Oranges," "Hard-Headed Ajo Charlie" and "The Banker and the Lightning" for example—will set you chuckling.

Another deals with tommyknockers, who according to legend are the spirits of miners who have been killed in the mine; they live in crevices and warn people of impending danger, if they are worth saving, by tossing a few pebbles before a rock-fall or cave-in. "Vows and Tommyknockers" has a serious aspect, though, with respect to mine safety.

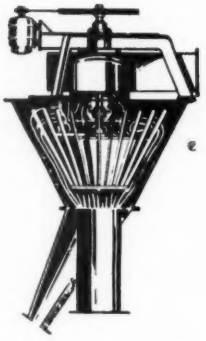
Mr. Dunning's latest book will be vastly enjoyed by all mining men who agree that worthwhile ore can be found in lighter "veins."

change from...

40 MESH

to

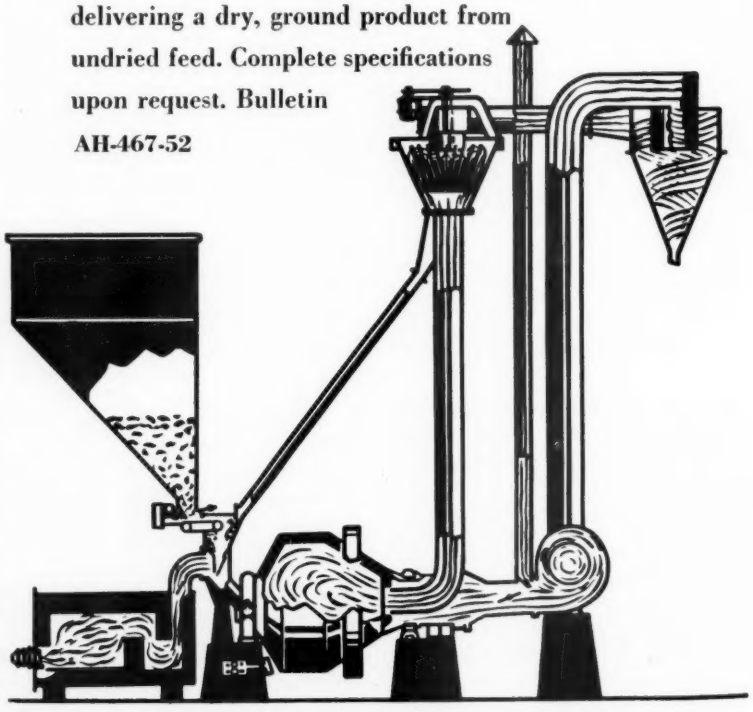
400 MESH



. . . in a few minutes, without interrupting operations. Yet any desired mesh may be maintained continuously. Ease of adjustment and close product control are possible with the . . .

"Gyrotor" Air Classifier

The Hardinge Gyrotor Classifier system, combined with a Hardinge grinding mill is an integrated grinding, classifying and product conveying system. Also available with an air-heating furnace for delivering a dry, ground product from undried feed. Complete specifications upon request. Bulletin AH-467-52



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manufacturers forum

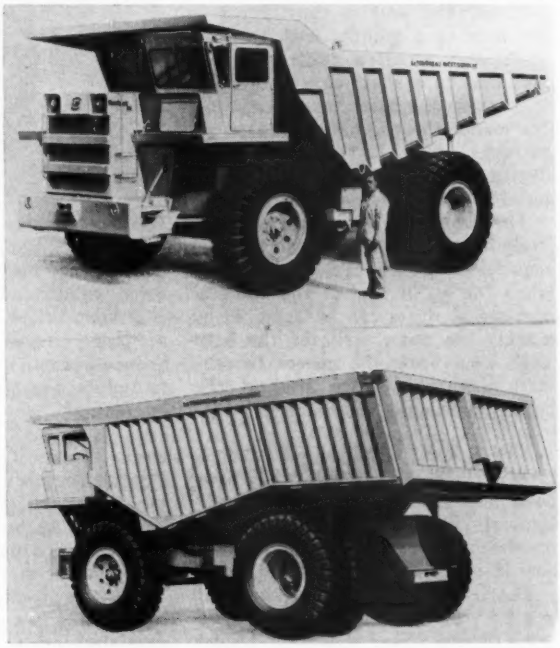
TO MAINTAIN CORRECT LIQUID LEVEL MEASUREMENT, a simplified controller has been developed by The Ohmart Corp., Cincinnati, Ohio. The instrument can be applied to almost any size or type of vessel and provides continuous level indication or control. It has sensing heads housed in thick steel tubes to meet explosion proofing requirements. Each

head is six in. long and can be increased by six in. increments to meet specific applications. With no moving parts, the instrument is installed so there is no contact with the material being measured, thus high or low viscosity materials can be controlled without clogging either the material or the instrument.

Recording and other instruments may be located as far as 500 ft away from the controller; thermal stability is between $-60°$ and $+150°$ F permitting accurate readability under conditions of extreme cold or heat.

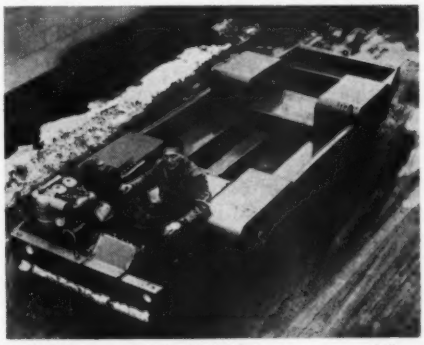
DESIGNED TO INCREASE THE FLEXIBILITY AND PRODUCTION of the Michigan Model 180 Tractor Dozer, the Construction Machinery Div. of Clark Equipment Co., Benton Harbor, Mich., announces the availability of a 170-hp General Motors diesel engine, the 6V-53 as optional equipment. It features two-stroke engine cycle, unit injector fuel system and maximum parts interchangeability. The other power plant for the Model 180 is the 162-hp Cummins C-175 diesel.

A SINGLE REAR-AXLE END DUMP TRUCK, the Model 65, is the latest addition to the Haulpak truck line of LeTourneau-Westinghouse Co., Peoria, Ill. This vehicle, a refinement of the Model 60, incorporates most of the features of the Haulpak line. Despite its unusual size, the Haulpak 65, by using extra high yield strength steels, and fabricated units in construction, weighs only 69,850 lb empty (54 percent of its 130,000 lb pay load). It is powered with a Cummins VT-12-700 Turbocharged engine, with transmissions available to accommodate this horsepower. The cab has been moved forward,

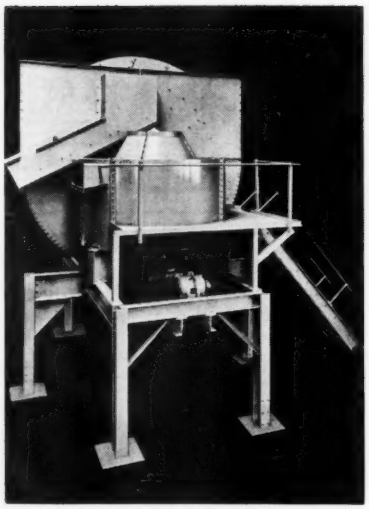


and necessary refinements have been made in the frame to accommodate either a rock body or a coal body. This interchangeability of bodies, with considerably different yardage capacities and the same tonnage ratings, is said to be the most significant single change in this new model. The rock body (top illustration) has a capacity of 42 cu yd, struck and will haul a pay load of 65 tons. The capacity of the coal body (bottom illustration) is 66 cu yd, struck and 65 tons.

FOR UNDERGROUND MINING, a new personnel carrier developed by Getman Brothers, South Haven, Mich., is the latest addition to the Getman line of equipment used in construction, mining and other industries. The new carrier, which can be adapted to a utility truck, can be used in low headroom mines as well as in high clearance areas. It has an overall height of 45 in., over-all width of 77 in., over-all length of 17 ft 8 in., and 98-in. wheelbase. The Getman carrier has four-wheel drive and four-wheel steering; is equipped with the Getman approved type scrubber; has $7{:}50 \times 16 - 8$ ply traction type tires, four-wheel hydraulic brakes, 12-volt lighting system and low cut-in generator of high capacity. With speeds up to 20 mph, it has a carrying capacity up to 5000 lb.



A DENSE MEDIUM SEPARATOR, known as the Norwalt, developed by Nortons–Tividale, South Africa, is now available in the United States and Canada, through sales-engineering offices recently established by the company at 307 N. Michigan Ave., Chicago 1, Ill. Primarily developed as a coal preparation machine, the Norwalt Separator also functions in any process where solids are to be separated according to their differing specific gravities in a dense medium suspension. The unit is constructed in the form of a cylinder with an inner cone over which a central boss is mounted on a shaft carried in bearings inside the inner cone away from the medium in the bath. Paddles, attached by arms to the central boss, during rotation sweep any sink material to the discharge point.



The design of the separator lends itself to modifications to suit specific requirements. Increase in capacity when the major part of the material consists of floats can be achieved by making the outer walls of the bath slope away from the center thereby increasing the surface area of the bath. Additional amounts of sink material can be handled by widening and duplicating the drainage wheel or other equipment for the removal of the sinks. When large sized materials are being treated, a lifting device can be incorporated in the floats discharge to reduce the amount of medium in circulation.

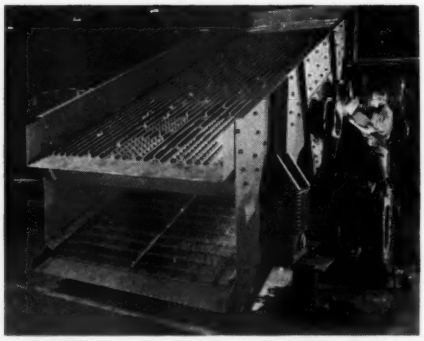
TWO OF THE NATION'S LARGEST IRON ORE SHOVELS have been equipped with specially-built General Electric silicon-controlled rectifier systems. Both machines are now in operation in Minnesota.

The G-E systems are incorporated in a Bucyrus-Erie model 270-B Shovel and a Marion Power Shovel Co. Model 191-M Shovel. Each machine has an 11-yd bucket capacity.

The shovels were designed to include silicon-controlled rectifiers for excitation and control of the generators on the hoist, swing and crowd motions. The SCR systems will provide the shovels with fast dynamic response to varying bank conditions.

Another feature of the project is that both systems were computer-tested before they actually were built. The shovels' characteristics, stipulated by the two manufacturers, were simulated on a computer and the shovels were put through their paces on paper. In this way, the digging characteristics were pre-tested to see how they would respond to various operating conditions in iron ore mining.

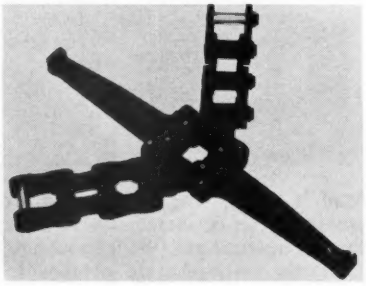
EIGHT BY TWENTY-FT, DOUBLE-DECKED, Ripl-Flo screen, with synchronized dual mechanism on test at Allis-Chalmers West Allis, Wis., Works, is said to be one of the largest vibrating screens built to date. The screen will be installed ahead of a ship loading conveyor to handle 1100 long tph of minus eight-in. iron ore, screening out the ½ by 0 in. material with less than 10 percent minus ½ in. left in the 8 by ½ in. Top deck of the screen is ⅝-in. cast manganese steel perforated plate with 2-in. square openings. The bottom is of ¼-in. diam manganese steel wire cloth with 7/16 by 5-in. rectangular openings. Two 20-hp, 1500-rpm, high-torque motors drive this 825-rpm screen, which has a ⅜-in. throw and a 22½° slope. It will be floor mounted with fixed brackets on a nest of dual steel springs to minimize vibration transmissions.



A RAPID-ADJUST CAM LOCK RIPPER with a new one-piece ripper point has been introduced by H&L Tooth Co., Montebello, Calif. Both ripper shank and one-piece point are forged of special high-alloy steel and formed under heat to create proper grain flow for extreme strength, stamina and wear-resistance.

With the Rapid-Adjust cam assembly and using only one H&L shank and point, the operator can achieve four ripping angles with ease and speed. Forward or rear position is attained by simple adjustment of the cam lever. Two additional angles are achieved by reversing the Flexpin-attached point. In conjunction with the new ripper and point, H&L offers a new cutter wing that trails behind the point in 21 in. width to loosen difficult and compacted material.

A REPLACEMENT COAL CONVEYOR CHAIN called the "Coal Caddy" for carrying coal on Joy 14 BU and 20 BU loading machines, Jeffrey 81 Series loading machines, and Lee-Norse continuous miners, has been announced by Mining Machine Parts, Inc., Cleveland, Ohio. The "Coal Caddy" features one-piece block links forged from high physical alloy steel. Both tapered or reversible conveyor flights are designed with non-welded attachments to eliminate the annealing effect of welding.



AN EPOXY RESIN COMPOUND Plastic Pack, for use in filling cavities between manganese wearing surfaces and structural steel member of crushers, is now available from Allis-Chalmers, Milwaukee 1, Wis. The resilient, non-shrinking compound is said to do away with the need for elaborate application preparations associated with zincing. Easy to pour, it can be applied at the crusher site, and has a maximum compressive strength of 16,000 psi. Plastic Pack is poured as a filler into the space between the head and mantle of top shell and concave ring.

—ANNOUNCEMENTS—

P. C. Manley

New executive assignments in **Long-Airdox Co.,** Oak Hill, W. Va., have been announced. **Paul C. Manley** has been named vice president and general manager; **Robert C. Nelson** has been appointed vice president of sales, and **Richard H. Mason** is assuming responsibility for all advertising and public relations.

R. C. Nelson

R. H. Mason

Manley, formerly vice president of Airdox Co., will report directly to the president and will be in charge of operations and will assume top executive authority in the absence of the president. Prior to his new position, Nelson had been director of advertising and sales promotion. Mason has been with the company in various sales, publicity and advertising capacities.

Will Mitchell, Jr., has been appointed director, research division, **Allis-Chalmers Mfg. Co.** He had been the division's acting director since September 1960, and orginally joined the company in 1947 as director of the basic industries laboratory.

Walter F. Crandall, formerly chief sales engineer of the **Wire Rope Corp. of America, Inc.,** has been promoted to plant manager at the company's main manufacturing plant in St. Joseph, Mo. He joined the company as a member of the engineering staff in 1949.

Barton M. Collinge has been appointed manager of the New York district explosives and mining chemicals department, **American Cyanamid Co.** He will direct all phases of marketing of Cyanamid's explosives and mining chemicals in New England and most of the Middle Atlantic Atlantic States from headquarters in Bound Brook, N. J.

E. C. Griggs has been named manager of the new U. S. sales organization of **Nortons-Tividale, Ltd.,** English manufacturers of coal preparation equipment. Griggs comes to his new position from Roberts and Schaefer, after serving many years as district sales manager for McNally-Pittsburg Mfg. Co. His new offices are in Chicago at 307 N. Michigan Ave.

James R. Gronseth has been named manager of the mine hoist department, **Nordberg Manufacturing Co.** Gronseth was previously mechanical engineer for Inland Steel Co. at Ishpeming, Mich.

Joy Mfg. Co. announces two new appointments; **John H. Fleming** is to be Technical Services manager, Coal Machinery Division with headquarters in Franklin, Pa., and **R. R. Fenner** has been named assistant district manager of the company's Denver Coal Office.

John Edward "Eddie" Lyons, mining and transit district manager for **Ohio Brass Co.,** in eastern Pennsylvania and western New York, has announced plans to retire at the beginning of 1962. Eddie has been with O–B since 1931 and before that was employed by General Electric and American Locomotive Co.

Myron R. Coughenour has rejoined **Connellsville Corp.** as a sales engineer. He began his career with the company in the 1920's and later joined, in succession, the Consolidation Coal Co. and Fairmont Machinery Co., where he served as a designer and estimator in coal preparation.

Harold B. Ewoldt has joined the **LeTourneau - Westinghouse Co.** as truck specialist, sales. With over 30 years of operating experience, he was at one time a district engineer for the U. S. Bureau of Mines, and has held staff and management positions with Calumet and Hecla, Copper Range Co., Cerro Corp., and Southern Peru Copper Co.

CATALOGS & BULLETINS

NULL BALANCE RECORDERS AND RECORDING CONTROLLERS. *General Electric Co., Schenectady 5, N. Y.* GEA-6887A, describes General Electric's complete line of single and multi-pen null balance recorders and recorder-controllers. Also discussed are multi-point recorders and multi-purpose indicators. Descriptions of typical measurements performed by the recorders and controllers are outlined in a special section. The illustrated bulletin contains information on features, dimensions, specifications, optional accessories and applications.

REPLACEMENT PARTS. *Columbia Steel Casting Co., Inc., 933 N. W. Johnson, Portland 9, Ore.* Bulletin number 1078 gives specifications of and information on the Columbia D-8-H heavy duty track shoe, and includes a discussion of the advantages of duplex furnace technique in the manufacture of replacement parts for tractors and shovels.

PUMP CATALOG. *Allis-Chalmers, Milwaukee 1, Wis.* Allis-Chalmers complete expanded pump line is described in the Pic-A-Pump catalog, which includes parts listings and prices along with a yellow reference section carrying data relating to pumps, hydraulic design, and general tables and charts frequently required in the application of moving liquids. Engineering data are conveniently arranged for selection of centrifugal, axial or mixed flow pumps best suited to individual and specific applications. The information permits ready "engineering" of the pumping units and selection of the materials of construction needed. The catalog is available on request on company letterhead.

HEAVY DUTY INDUSTRIAL LININGS. *Stonhard Co., Inc., Dept. HDS, 440 Terminal Commerce Bldg., Philadelphia 8, Pa.* "How to Keep Coal From Tearing Holes in Your Budget" is the name of an illustrated booklet which introduces a new lining material for repair and maintenance of equipment for handling coal and other abrasive matter in bulk. Stonhard heavy-duty industrial lining is used in coal preparation, electric power and similar plants to repair chutes, pipes, flumes, concentrating tables, sumps, cones and other equipment. The lining material is simply troweled on the metal surface in one coating, without the need of disassembling any parts, and adheres tightly and dries and hardens within hours.

TWO-STAGE OIL FILTERS. *Vickers, Inc., Div. of Sperry Rand Corp., Detroit 32, Mich.* Bulletin I & M-5111, describes new OFM Series oil filters for use in mobile and industrial hydraulics systems. The filters, available in three basic sizes up to 300 gpm flow rating and a variety of porting arrangements, feature two-stage filtration to trap and retain particles over 8 to 10 microns in size. The four-page bulletin includes photographs, a cross-section drawing showing flow paths, typical application circuits and pressure drop curves. A visual comparison is given of single stage filter paper versus the Vickers two-stage filter media.

(more on next page)

Catalogs & Bulletins

continued from previous page

24-YD SCRAPER. *Advertising Dept., Euclid Div., General Motors, Hudson, Ohio.* The Euclid Model S-24 scraper, which has a payload capacity of 24 cu yd struck and 32 yd heaped, is described in a new folder, Form No. 514, illustrated with exploded and cut-a-way views to explain basic design features including the GM 12-cylinder 432-hp diesel engine, Torqmatic drive, hydraulic operation of bowl, blade, and ejector, and other major components. Condensed specifications and charts showing grade ability and estimated hourly production on hauls of varying length are included.

BELT FEEDER. *B-I-F Industries, P. O. Box 276, Providence 1, R. I.* Maintenance of a constant weight of material on a moving belt by actuation of a positive-acting feed gate is the principle of operation for B-I-F's Belt Gravimetric Feeder Model 37–04, described in Specification Data Ref. No. 37–04.201–1. Effective and accurate use of this concept has resulted in a feeder for precise feeding, by weight, of almost any dry, flowable material, such as minerals and ores. The 37–04 can attain a feed rate of as much as 3000 lb per minute (90 tph) with 50 lb per cu ft material, and through its weight-sensing section and Sens-A-Gram controller, will adjust gate position instantly and proportionally to maintain a constant belt load. The folder contains illustrations, dimensions, specifications of the Model 37–04 .

WEAR CASTINGS. *Amsco, Chicago Heights, Ill.* To help buyers make intelligent decisions when it comes to the purchase of wear parts, Amsco has issued an informative 16-page booklet, "Facts About Manganese Steel Castings." It explains how American Manganese Steel Division of American Brake Shoe Co., builds impact and abrasion resistance into every casting.

INSTRUMENT PRODUCT DATA. *The Bristol Co., Waterbury 20, Conn.* Product data A113.3.3-2, describing the Series 670 Metagraphic pneumatic receiver, has been released. Photographs and engineering drawings supplement discussion of the instrument's construction, design, size and capabilities. The Series 670 is an important addition to the company's line of "Functionally Unitized Instruments." Such instruments are engineered to be functionally compatible with a manufacturing or processing system. Transmitting, controlling and supervising instruments are placed—without grouping—in the most desirable location.

UNIVERSAL JOINTS. *Twin Disc Clutch Co., Racine, Wis.* Six pages of information on the new line of Twin Disc-GWB Universal Joints highlight the current issue of *Production Road*, Twin Disc Clutch Company's quarterly magazine. Other articles cover the split-torque transmission in Caterpillar's new 630 and 631 Tractors; a Lorain Shovel on a dam-building project; and a new Barber-Greene Trap Loader which can load a 12-ton truck in half a minute.

ATLAS COPCO ORGANIZATION—PRODUCTS. *Atlas Copco, Inc., Eastern Div., 610 Industrial Ave., Paramus, N. J., or Pacific Div., 930 Brittan Ave., San Carlos, Calif.* An eight-page illustrated booklet, "This is Atlas Copco," has been designed for quick reading, and gives a brief history of the 88-year-old, world-wide organization, the location of its offices and warehouses in the United States, and the products it makes available to the mining, construction and manufacturing industries in this country.

HYDRAULIC FILTERS. *Vickers, Inc., Div. of Sperry-Rand Corp., Detroit 32, Mich.* Described and illustrated in bulletin 61-78 are Tell-Tale Filters for suction line use in hydraulic systems. On the outside of the filter is an indicator showing when cleaning is required, and indicating that the filter is bypassing if the warning is ignored. Filter elements are available in degrees of filtration ranging from 74 to 238 microns, and for flow rates from 0 to 120 gpm. All major parts are shown in the bulletin by a large cutaway drawing, and complete dimensional data is given on all models.

ELECTRIC VIBRATORS. *Syntron Co., 703 Lexington Ave., Homer City, Pa.* Bulletin No. 81461 contains complete data and specifications of the company's 14 standard pulsating-magnet electric vibrators, as well as three pneumatic and hydraulic units. The vibrators are designed to promote the free flow of bulk materials through bins, hoppers and chutes.

RECORDERS. *General Electric Co., Schenectady 5, N. Y.* GEA-6933A describes the company's full line of direct- and servo-operated switchboard and portable recorders, relating information on 19 different types of single and multi-pen ink and inkless, strip and round chart recorders. The bulletin also lists over 40 different electrical and physical parameters that can be measured by these recorders in various industrial applications.

LUBRICATING OIL. *Industrial Products Dept., Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.* Data on Solnus "C", a general-purpose lubricating oil recommended for extremely wet conditions, has been incorporated in Sun Oil Company's technical bulletin #17 on this line of oils. Ten viscosity grades of low cost Solnus Oils are now described in detail.

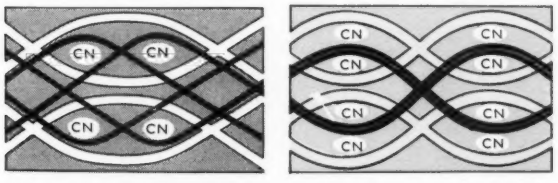
TRACTOR–SHOVEL. *The Yale & Towne Mfg. Co., Trojan Div., Batavia, N. Y.* The company has just released a specification bulletin explaining the features that enable the new model 404 Trojan tractor-shovel to deliver maximum production for the user, combined with fast, economical operation. The bulletin lists numerous mechanical features, including diesel engine options; filtered hydraulic system; main boom hydraulic lift cylinders, plus standard and optional equipment for the vehicle.

Index to Advertisers

NEW ROYAL GOLD BURRO BELTING

Built better to last longer

When all the facts are in, it's clear that no other interwoven belting can match U.S. Royal Gold Burro. This new belting has not only been made highly fire resistant without sacrificing strength, but its high-visibility gold cover insures maximum safety in dimly lit underground areas.



While inferior belts (left) have only one base layer to protect tension members after the PVC layer is worn through, the Royal Gold Burro (right) has an extra layer of cotton-nylon fillers to give added protection to the tension members—longer life to the belt. Note central placement of nylon tension members for maximum pulling strength.

And unlike other belting, whose strength members are covered by only one layer of base yarn, the yarn-dipped, all-PVC Royal Gold Burro has an extra layer of cotton-nylon fillers beneath its tough cover to give maximum protection to its extremely high-strength nylon tension members.

Extra strands of filament nylon on the belt's edges provide greater rip and tear resistance, add to Royal Gold Burro's excellent troughability and training characteristics.

Low-cost Royal Gold Burro Belting is available in standard widths and in lengths to 1,200 ft. For further information and on-the-spot assistance, call your nearest US Distributor.

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

United States Rubber

MECHANICAL GOODS DIVISION

Rockefeller Center, New York 20, N. Y.

New M-S-A® Pager gives you the convenience and flexibility of a telephone with the amplification of a loud speaker

Now, with one versatile communications unit, you can page key personnel over a loud speaker or converse semi-privately by phone. A flip of the switch on the new M-S-A Pager lets you do either.

Uses Existing Lines

The new unit is a completely self-contained, transistorized telephone. Individually battery-powered, these units utilize existing phone lines, and can be used in conjunction with most other telephones.

Simultaneous Paging

Ten or more Pagers can be installed on a single line. This makes it quite simple to page key men from a number of points . . . simultaneously. Once the man answers, a flip of the switch converts the Pager into a regular telephone for private or semi-private conversing.

24 Volts for Paging . . . 12 Volts for Talking

Two dry cell batteries provide the power source. And the power is expended only when the unit is in use, thus conserving battery life. Estimated battery life: 2 to 3 months on a 5% duty cycle.

Easy Installation and Maintenance

Weighing about 25 pounds, the M-S-A Pager can be mounted on a timber or a rib. All parts readily accessible with removal of four fastening screws which open the front half of the case. Transistors are vibration-proof . . . no filaments . . . so high efficiency, long life are assured.

For additional information, ask the MSA representative to call. And write us for helpful new product data bulletin.

Mine Safety Appliances Company, Pittsburgh 8, Pennsylvania. In Canada: Mine Safety Appliances Company of Canada, Ltd., 500 MacPherson Avenue, Toronto 4, Ontario, Canada.

MINE SAFETY APPLIANCES COMPANY MSA